

ANOMIOPSYLLINAE (SIPHONAPTERA: HYSTRICHOPSYLLIDAE), II.
THE GENERA *CALLISTOPSYLLUS*, *CONORHINOPSYLLA*,
MEGARTHROGLOSSUS, AND *STENISTOMERA*

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ABSTRACT.— The subfamily Anomiopsyllinae in North America consists of five genera: *Anomiopsyllus* Baker; *Callistopsyllus* Jordan and Rothschild; *Conorhinopsylla* Stewart; *Megarthroglossus* Jordan and Rothschild; and *Stenistomera* Rothschild. The revision of *Anomiopsyllus* was the subject of a previous paper, and the remaining four genera are treated herein. The North American genus *Jordanopsylla* Traub and Tipton and the Palearctic genus *Wagnerina* Ioff and Argyropulo had been included in the subfamily Anomiopsyllinae by Ioff and Argyropulo, but these two genera possess characters which are not consistent with the current definition of the subfamily. All species are considered to be "nest fleas," but modifications for a nest habitat are more pronounced in some species than others. Diagnoses, descriptions, and keys are given for genera and most species. In addition, illustrations, host records, and geographical distribution are given for each of the 21 species.

The family Hystrichopsyllidae Tiraboschi, 1904, consists of nine subfamilies. In four of the subfamilies (Acedestiinae, Ctenophthalminae, Dinopsyllinae, and Stenoponiinae) genal combs are present. In three additional subfamilies genal combs are present except in certain genera (Hystrichopsyllinae except *Atyphloceras*, Neopsyllinae except *Catallagia* and *Delotelis*, and Rhadinopsyllinae except *Wenzella* and *Trichopsylloides*). There is no genal comb in the subfamily Anomiopsyllinae, and it is vestigial or lacking in Listropsyllinae. In Anomiopsyllinae the eye is reduced, vestigial, or absent. The pleural arch is absent, the lateral metanotal area is reduced or absent, the upper anterior margin of the metepisternum is concave, and there is no striarium on abdominal segment II. There is marked reduction in chaetotaxy in *Anomiopsyllus*, not marked in *Stenistomera*, and intermediate in the other three genera of the subfamily.

Anomiopsyllinae in North America consists of five genera: *Anomiopsyllus* Baker; *Callistopsyllus* Jordan and Rothschild; *Conorhinopsylla* Stewart; *Megarthroglossus* Jordan and Rothschild; and *Stenistomera* Rothschild. The genus *Anomiopsyllus* was revised by Barnes, Tipton, and Wildie (1977) in the first of a series of papers on the family

Hystrichopsyllidae. The remaining four North American genera are discussed in this paper.

When Traub and Tipton (1951) described the genus *Jordanopsylla*, they indicated that it differed from the other genera of Anomiopsyllinae as follows: "The metepimere is free; the pleural arch is present; the upper margin of the metepisternum is convex; and the internal marginal tubercle of the metepisternum is vestigial." Based on these differences they erected the tribe Jordanopsyllini. Ioff and Scalon (1954) recognized the morphological similarities between *Jordanopsylla* and *Wagnerina* Ioff and Argyropulo and placed the latter with *Jordanopsylla* in the tribe Jordanopsyllini. The characters given above provide ample reason to question inclusion of these two genera in the subfamily Anomiopsyllinae.

Eopsylla Argyropulo, like *Wagnerina*, is palearctic in distribution and so will not be considered here.

The five North American genera of Anomiopsyllinae exhibit ecological as well as morphological affinities. Their morphological similarities reflect their shared evolutionary history and habitat. They are considered "nest fleas," which means they are better adapted to conditions in the nest than on the

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host. Traub (1972) listed characters which appear to be common to nest fleas, and all five genera possess these characters in varying degrees. The genus *Anomiopsyllus* appears to have better adapted to the nest environment than other genera of the subfamily. The outstanding features of *Anomiopsyllus* anatomy that appear to be adaptive are "complete eyelessness, extreme reduction in number of setae and spines, extensive loss and fusion of structures in the metathorax, and loss of structures in both meso- and metacoxae." In contrast to the highly modified nature of the thorax, the abdominal segments are only moderately specialized, though marked by loss of some structures in the male genitalia" (Barnes et al. 1977). Other nest fleas share most of these morphological characters. If *Anomiopsyllus* represents the extreme in adaptation to nest conditions, *Stenistomera* may represent a more moderate adaptive position in that it has well-developed setation, including a comb on the mesotibia.

DISCUSSION

Species density of fleas is much greater in the western half of the United States than in the eastern half. Hubbard (1947) indicated there were 33 genera and 56 species and subspecies of fleas known from east of the 100th meridian, and 67 genera and 230 species and subspecies were known from west of the 100th meridian. In the intervening years since 1947 several taxa have been described and thus these figures have been adjusted upward. For example, Benton (in press) lists 67 species and subspecies of fleas in the United States east of the Mississippi River. Of the 33 genera listed by Hubbard 19 genera occur only west of the 100th meridian. If the line which divides "east" and "west" is moved east 138 miles to the 98th meridian, then 27 genera are exclusively western. By way of comparison, there are two genera that occur only in the east. Dice (1943) emphasized the great diversity of habitats in the western United States in that he lists 15 biotic provinces west of the Mississippi River, but only four east of the Mississippi River. Jellison (1979) has pointed out that diversity of habitat is reflected in the large number of species

of rabbits, squirrels, and other host animals in the west.

Simpson (1964) calls attention to a west-east species gradient for mammals and uses the term *front* to denote an abrupt decline in species density along a species density gradient. He also points out that mean annual precipitation and topographical relief are the two main factors that contribute to fronts. The 100th meridian corresponds roughly with the 20-inch isohyet, and the high relief topography of the west contrasts sharply with the low relief of the plains states and the relatively low relief of the eastern United States.

In Utah, a state of high relief, there are approximately 115 species and subspecies of fleas in an area of about 85,000 square miles. Hopla (1979) estimates there are 40 species and subspecies of fleas in Kansas, a state of low relief with an area of slightly more than 82,000 square miles.

Traub (1979) cautioned that "while mean annual precipitation and topographical relief are of course highly important factors, one must also consider the geologic history of the two areas and the origins and dispersals (history, biogeography, phylogeny and evolution) of the respective host and siphonapteran faunas."

The distributional pattern of ectoparasites may be influenced by their life-style. Insect parasites which are parasitic during all stages of their life history and are host specific tend to have distributional patterns similar to their hosts. On the other hand, insect parasites with at least one free-living stage and which are not host specific often have distributional patterns somewhat different from those of their hosts. Fleas in the subfamily Anomiopsyllinae are characterized as "nest fleas." There are 35 recognized species and subspecies in the five North American genera, of which four genera (33 species) occur west of the 98th meridian only and one genus (*Conorhinopsylla*, 2 species) occurs only east of the 100th meridian. They have been collected from the nests of *Neotoma* species and other nest-building rodents; although a few specimens have been collected from species of *Ochotona*, *Spilogale*, and other nonrodent hosts.

Key to North American Genera of Anomiopsyllinae (Males)

1. Pronotal comb absent; chaetotaxy greatly reduced; eye absent; caudoventral margin of coxae II and III with acuminate spur *Anomiopsyllus*
- Pronotal comb present; chaetotaxy variable; eye vestigial or absent; caudoventral margin of coxae II and III without acuminate spur 2
- 2(1). Sternum VIII greatly modified, spiniforms on distal apex; clasper elongate (Figs. 18, 19, 22, 23) *Conorhinopsylla*
- Sternum VIII not modified, without spiniforms on distal portion; clasper not elongate 3
- 3(2). Eye vestigial; sternum VIII covers more than one-half of distal arm of sternum IX; apex of movable process of clasper on a level with or extends only slightly dorsad of immovable process of clasper *Megarthroglossus*
- Eye absent; sternum VIII covers less than one-half of distal arm of sternum IX; apex of movable process of clasper extends well beyond apex (dorsad) of immovable process of clasper 4
- 4(3). Frons evenly convex; dorsal margin of aedeagal apodeme not extended into long coiled rod; preantennal area and abdominal sterna lacking enlarged bristles; mesotibia without dorsolateral comb *Callistopsyllus*
- Frons subacuminate; dorsal margin of aedeagal apodeme extended into long coiled rod; preantennal area and abdominal sterna possessing slightly or greatly enlarged bristles, mesotibia with dorsolateral comb *Stenistomera*

Callistopsyllus Jordan and Rothschild

Callistopsyllus Jordan and Rothschild 1915:46 (Type species *Callistopsyllus terinus* Rothschild 1905 as *Ceratophyllus*); Ewing 1929:162; Jellison and Good 1942:26; Ewing and Fox 1943:102,111; Hubbard 1947:274,281; Holland 1949b:55,96; Traub and Tipton 1951:267-268; Traub and Hoff 1951:1-23; Jellison, Locker, and Bacon 1953:17; Hopkins 1957:64-87; Parker and Howell 1959:597-604; Hopkins and Rothschild 1962:354; Jellison and Glesne 1967:28-29; Lewis 1974:147-167.

Callistopsyllus was described by Jordan and Rothschild in 1915 and *Ceratophyllus terinus* Rothschild, 1905, was designated as type species. Since the original description, three new species have been described: *C. deuterus* Jordan, *C. campestris* Holland, and *C. paraterinus* Wagner, but the latter was subsequently placed as a junior synonym of *terinus*. Our study has demonstrated that morphologic differences are slight and intergrade in several geographic localities. It is considered advisable to regard *Callistopsyllus* as monotypic, with *deuterus* and *campestris* as subspecies of *C. terinus*. *Callistopsyllus terinus* is distributed widely over most of western North America. In recent correspondence, Traub (1978) expressed doubt that a single species of a nest flea would have such

broad distribution. However, morphological characters used to separate described species are within the range of variation found in one locality, especially in New Mexico. The original description of *C. deuterus* matches the majority of specimens collected in eastern California and western Nevada. Reliable separation is difficult. Even the validity of subspecies is doubted, because the slight differences are not consistently correlated with geographic distribution. However, subspecific status is maintained at this time to preserve currently recognized names and to facilitate study of morphological variation. Specimens from Alberta and Saskatchewan have been described as *C. campestris*. At localities in Montana, Wyoming, and North Dakota, specimens bearing a resemblance to *campestris* have been found with typical *terinus*.

DIAGNOSIS.—There are two rows of preantennal bristles in *Callistopsyllus* and four rows in *Stenistomera*. *Callistopsyllus* may be separated from *Megarthroglossus* and *Conorhinopsylla* by the absence of an eye and from *Anomiopsyllus* by the presence of a pronotal comb. One of the most dis-

tinguishing characteristics of *Callistopsyllus* males is the very prominent movable process which greatly exceeds the length of the fixed process and is very large in relation to the comparatively small body. The movable process has two spiniform bristles, similar to those of *Stenistomera* and some *Anomiopsyllus* but unlike *Conorhinopsylla* and *Megararthroglossus*, which lack spiniform bristles.

DESCRIPTION.—HEAD: Interantennal suture present. Frontal tubercle present. Frontal margin evenly rounded. Eye absent. Head bristles not spiniform as in some *Stenistomera*. Two rows of preantennal (or preocular) bristles; anteriormost row usually posterior to cibarial pump. Antenna of male enlarged greatly over that of female. Pedicel of antenna of male extends over part of club. Trabecula centralis absent. Antennal fossae extend to beyond posterior border of head. Anteroventral angle (oral angle) of head with sharp, small labrum. Maxillary lobe as in *Megararthroglossus*. Labial palp with 4 segments which extend beyond foretrochanter; apex more or less symmetrical; other members of Anomiopsyllinae with shorter labial palpi except *Megararthroglossus* which has 5 segments extending well beyond trochanter, with asymmetrical distal segment. Apex of genal lobe acute.

THORAX: Pronotal comb with 15–18 (usually 17) teeth on both sides, each sex. Pleural arch absent. Metasternum and metepimeron fused with metepisternum. Metepisternum lacks bristles. Lateral metanotal area absent. Metepimeron with spherical spiracle. Prosternum not distinctive, without bristles, triangular portion with apex directed posteriorly as in *Anomiopsyllus*. Mesosternum and mesepimeron with one long bristle each. Metanotum with about 11 large bristles on each side, about 4 tiny bristles between these. Mesonotum with one row of about 4 bristles on each side plus 3 pseudosetae.

LEGS: Coxae lack spurs as in *Anomiopsyllus*; coxa I with one long apical bristle; mesocoxa with partial longitudinal break; each femur with heavy, long, curved bristles at apex; none elsewhere on lateral surface; with small bristles along dorsal margin; mesotibia lacking comblike arrangement of setae as in *Stenistomera*. Metatarsus with 4 lateral,

curved setae plus medially displaced proximal pair.

ABDOMEN: Segment II with spherical spiracle. Each abdominal segment with single row of bristles; tergum I with 3–4, terga II–IV with 5, and terga V–VI with 4 long bristles; abdominal tergum VII with 2–3 shorter bristles; 3 antepygidial bristles in both sexes, middle bristle longest, upper bristle shortest. Ventral sternum II with no bristles, sterna III–VII with 2–5 long bristles (2 in male). Abdominal tergum I with 3–5 (usually 4) apical spinelets on each side; abdominal tergum II with 1–4, III with 1–3 (usually 1), IV with 0–1 (usually 0) apical spinelets on each side.

Modified Segments—Male: Movable process extends dorsad beyond fixed process of clasper; with two blunt spiniform bristles. Caudal margin of sternum VIII rounded, not distinctively shaped; does not ensheathe sternum IX. Sternum IX shaped like neck and head of goose, beak pointed dorsad, with 10–12 short, thick setae directed caudad. Aedeagal apodeme extends as far cephalad as apex of manubrium or beyond; blade shaped, anterior and posterior ends curved slightly dorsad; neck constricted; dorsal margin with groove which receives ventral margin of manubrium. Median dorsal lobe small, distinct, as is crochet and apex of sclerotized inner tube. Penis rods long, coiled almost one full turn.

Modified Segments—Female: Caudal margin of sternum VII curved as in smooth arc, lacking lobes and sinuses. Anal stylet slender, almost 4 times as long as broad; apical seta long, with 2 tiny setae near apex; 1 dorsal, 1 ventral. Spermatheca with oval bulga; no collar. Length of hilla and bulga approximately equal.

Callistopsyllus terinus (Fox)

Ceratophyllus terinus Rothschild 1905:158.

DIAGNOSIS.—Variations of taxonomic value are found only in male genitalia, primarily the movable process of the clasper. Remaining characters (of head, mouth parts, antennae, pronotum, legs, etc.) are as given in the preceding description and are found in specimens throughout the range of *C. terinus* spp. The following discussion applies to varia-

tions or consistent characters of the three recognized subspecies of *C. terinus*. The purpose of the abbreviated form is to shorten the diagnosis given under each subspecies.

MALE: Fixed process of clasper low, convex, evenly rounded with single large bristle. Finger somewhat triangular, variable according to distribution and subspecies. Placement of two spiniforms varies, closely together in some specimens but more widely separated in others. No measurements were necessary since no pattern of placement is associated with recognized subspecies or with distribution. Distal arm of sternum IX paired, somewhat triangular. Caudal margin evenly convex except some specimens with slight notch, small thick bristle, other specimens (some *campestris* and some northern *terinus* in Idaho) with pronounced angle about midway. About 15 to 21 variously sized bristles along caudal margin and around apex. Some specimens (sometimes from single collections site) have unusually heavy bristles along caudal margins. The anterior portion is membranous. The proportions of the membranous anterior portions match the more sclerotized caudal portions; for example, the apices of most *deuterus* are more slender than either *terinus* or *campestris* with regard both to the membranous apex and the sclerotized caudal margins and structures between. The basal portion has distinctive sclerites. While their shape is complex, differences among the three subspecies are inconsistent and unreliable for subspecies discrimination. Sclerites of the aedeagus have little or no variation among specimens examined.

FEMALE: Variations are slight. Caudal margin of sternum XII smoothly curved, with no lobes, sinuses, or angles; sometimes fairly concave. Hilla is longer than, shorter than, or equals bulga. Duct of spermatheca sclerotized for almost entire distance between spermatheca and bursa copulatrix. Length of sclerotized portion varies among specimens and variations in length are of no diagnostic value.

The differences between subspecies of *terinus*, the only valid species of *Callistopsyllus*, are minor. However, they are sufficiently distinctive to allow construction of a key for males.

TABLE 1. Distribution of subspecies of *Callistopsyllus terinus*.

AREA	<i>C. t. campestris</i>	<i>C. t. deuterus</i>	<i>C. t. terinus</i>
Arizona		X	X
California		X	X
Colorado		X	X
Idaho			X
Montana	X		X
Nevada		X	X
New Mexico			X
Oregon		X	X
South Dakota			X
Utah			X
Wyoming	X		X
Baja California		X	
Alberta	X		
British Columbia			X
Saskatchewan	X		

Key to subspecies of *Callistopsyllus terinus*

1. Males 2
- Females indistinguishable
- 2(1). Apex of movable process bluntly rounded, slightly tapered from base to apex; distributed from northern Great Plains to New Mexico *campestris*
- Apex of movable process acutely rounded, markedly tapered from base to apex; distribution general 3
- 3(2). Anterior border of movable process convex with widest portion just above base; distribution—Baja California, California, western Nevada *deuterus*
- Movable process triangular, anterior margin with widest portion next to base; distribution—Sierra Nevada and east to central North America, Mexico north to northern Great Plains *terinus*

Callistopsyllus terinus terinus Rothschild

Figs. 4, 7, 10, 13, 14, 99

Ceratophyllus terinus Rothschild 1903:158; Baker 1905:134,151.*Callistopsyllus paraterinus* Wagner 1940:465.*Callistopsyllus terinus* Jordan and Rothschild 1915:46; Jellison and Good 1943:26; Ewing and Fox 1943:111; Hubbard 1947:281; Holland 1949b:96; Tipton and Allred 1951:105-114; Ecke and Johnson 1952:36; Jellison, Locker, and Bacon 1953:17; Morlan 1955: 93-125; Stark 1959:97; Hopkins and Rothschild 162:355; Glesne 1967:28; Allred 1968:75; Tipton and Saunders 1971:18; Jellison and Senger 1973:19; Lewis 1974:147-167; Ego-scue 1976:476TYPE HOST.— *Citellus columbianus*

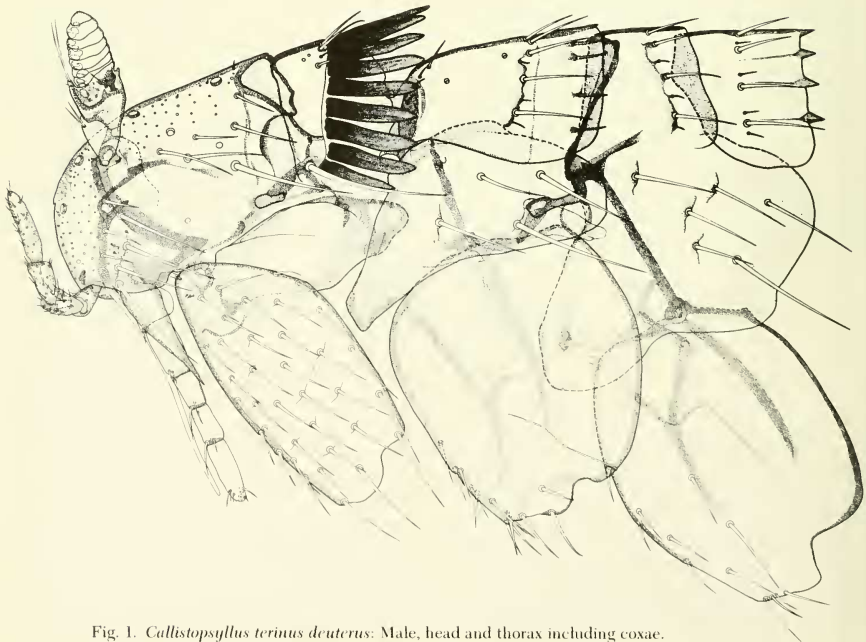
TYPE LOCALITY.— Mable Lake, British Columbia, Canada.

TYPE SPECIMEN.— British Museum (Natural History), London, England.

DIAGNOSIS.— MALE: Finger triangular; broad toward base with narrow, rounded apex, anterior and caudal margins nearly always straight (Fig. 4). Caudal border of distal arm of sternum IX evenly rounded apex narrow. (Fig. 7).

TABLE 2. Host associations of *Callistopsyllus terinus* subspecies.

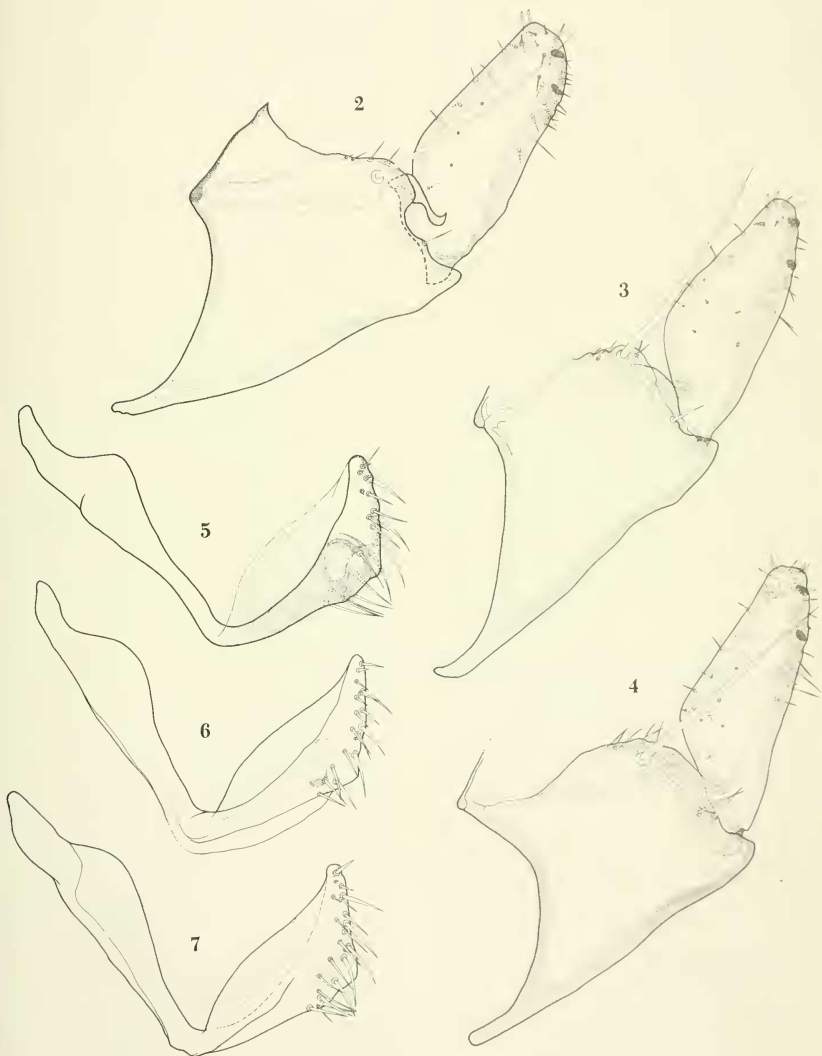
HOST SPECIES	<i>C. t. campestris</i>	<i>C. t. deuterus</i>	<i>C. t. terinus</i>
<i>Dipodomys ordii</i>	X		X
<i>Eutamias speciosus</i>		X	
<i>Eutamias quadricittatus</i> <i>ingoensis</i>		X	
<i>Microtus montanus dutcheri</i>		X	
<i>Microtus mordax sicrrae</i>		X	
<i>Neotoma</i> nest			X
<i>Perognathus</i> sp.	X		
<i>Peromyscus</i> sp.	X	X	X
<i>Peromyscus boylii</i>			X
<i>Peromyscus crinitus</i>		X	X
<i>Peromyscus eremicus</i>			X
<i>Peromyscus maniculatus</i>	X	X	X
<i>Peromyscus m. artemisiae</i>			X
<i>Peromyscus m. gambeli</i>			X
<i>Peromyscus m. osgoodi</i>	X		X
<i>Peromyscus m. sonoriensis</i>		X	X
<i>Peromyscus truei</i>		X	X
<i>Spermophilus columbianus</i>			X
<i>Tamiasciurus hudsonicus</i> <i>albolinbatus</i>			X

Fig. 1. *Callistopsyllus terinus deuterus*: Male, head and thorax including coxae.

FEMALE: Caudal margin of sternum VII faintly concave. Bulga of spermatheca about $1\frac{1}{2}$ times as long as wide, shorter than hilla.

DISTRIBUTION.— ARIZONA: Coconino and Navajo Counties. BRITISH COLUMBIA: Eagle

Pass, Dawson Falls, Marble Lake. CALIFORNIA: Nevada and Siskiyou counties. COLORADO: Larimer and Montezuma counties. IDAHO: Bingham, Butte, and Jefferson counties. MONTANA: Beaverhead, Park, and



Figs. 2-7. Males, claspers: 2, *Callistopsyllus terinus campestris*; 3, *C. t. deuterus*; 4, *C. t. terinus* Sternum IX; 5, *C. t. campestris*; 6, *C. t. deuterus*; 7, *C. t. terinus*.

Petroleum counties. NEVADA: Douglas, Nye, and Washoe counties. NEW MEXICO: Lincoln, Otero, Sandoval, San Juan, Santa Fe, and Taos counties. OREGON: Deschutes, Harney, and Jefferson counties. SOUTH DAKOTA: Custer County. UTAH: Beaver, Box Elder, Daggett, Iron, Juab, Kane, Millard, Piute, Rich, San Juan, Tooele, Utah, Uintah, Wasatch, and Washington counties. WYOMING: Big Horn, Green River, Lincoln, Park, Sweetwater, and Weston counties.

MATERIAL EXAMINED.—ARIZONA: (Cocino County) 3 ♂, 3 ♀, ex *Peromyscus truei* (TC-267), Tuba City, 23-1-1969; (Navajo County) 2 ♂, ex *Peromyscus truei* (B778), 31 km SW Holbrook, 26-IV-1949. COLORADO: (Larimer Co.) 1 ♂, ex *Peromyscus maniculatus*, Rocky Mountain National Park, 7-VII-78; (Montezuma Co.) 2 ♂, ex *Peromyscus maniculatus*, Mesa Verde National Park, 26-V-1962; (Park Co.) 1 ♂, ex *Peromyscus maniculatus*, 3.2 km S Fairplay, 11-VIII-1949. IDAHO: (Bingham Co.) 1 ♀, ex *Peromyscus maniculatus* (19Y) National Reactor Test Site (AEC-NRTS), 12-VIII-1966 (BYU); 1 ♀, same host, same location, 23-IX-1966 (BYU); 1 ♂, 1 ♀, ex rodent nest, AEC-NRTS (TRA), 11-X-1966 (BYU); 2 ♂, 3 ♀, ex *Peromyscus maniculatus*, AEC-NTRS (33y), 19-II-1967 (BYU); 1 ♀, ex *Neotoma* nest, AEC-NRTS (33Y), 10-III-1967; 1 ♂, 1 ♀, ex *Peromyscus maniculatus*, AEC-NRTS (19H), 3-VII-1967 (BYU); 1 ♂, 2 ♀, same host, AEC-NRTS (33Y), 20-VIII-1967 (BYU); (Butte Co.) 1 ♀, same host, AEC-NRTS (38Y), 19-II-1967 (BYU); 2 ♂, 1 ♀, same host, AEC-NRTS (36HF), 22-III-1967 (BYU). NEVADA: (Nye Co.) 6 ♂, 7 ♀, ex *Peromyscus maniculatus* (334), 28 km NE Pahrump (Timber, Rocky Mt.) 19-XII-1949; (Washoe Co.) 1 ♀, ex *Peromyscus maniculatus* (44-E-16), 19-IV-1944. OREGON: (Jefferson Co.) 2 ♂, ex *Peromyscus* sp., Ames Ranch, Madras, 20-V-1958. NEW MEXICO: (Lincoln Co.) 1 ♂, 3 ♀, ex *Peromyscus truei*, 3-IV-1948; (Otero Co.) 3 ♂, 1 ♀, ex *Peromyscus truei* (D443) 10 km E La Luz, Lincoln National Forest, 1300 m, 22-III-1949; 3 ♂, 1 ♀, 11 km NE La Luz, 1500 m, 24-III-1949; (San Juan Co.) 2 ♂, 1 ♀, ex *Peromyscus maniculatus* (B778), 73 km E Bloomfield, 1900 m, 18-V-1949; (Santa Fe Co.) 2 ♂, ex *Peromyscus maniculatus*, (4697) (697) Santa Fe,

2150 m, 2-IV-1953; (Taos Co.) 3 ♂, 1 ♀, ex *Peromyscus* sp., Pecos, 22-II-1941, McMurry (Jellison). (Some male specimens from New Mexico and the male from South Dakota are *terinus* near *campestris*.) SOUTH DAKOTA: (Custer Co.) 1 ♂, ex *Peromyscus maniculatus* (B1511), 45 km W Custer (1660 m, rock ledges, pine, juniper) 6-VI-1950. UTAH: (Beaver Co.) 1 ♂, ex *Peromyscus maniculatus*, Puffer Lake, 25-VI-1957, D. M. Allred (BYU); (Box Elder Co.) 1 ♀, same host, Yost, George Creek, 9-VII-1957, D. M. Allred (BYU); (Daggett Co.) 2 ♂, 1 ♀, same host, Linwood, 15-VII-1954, C. L. Hayward (BYU); 1 ♀, ex *Dipodomys ordii*, Bridgeport, 1-VII-1954, C. L. Hayward (BYU); (Iron Co.) 1 ♂, ex *Peromyscus maniculatus*, Cedar Break National Monument, 21-VII-1953, D. E. Beck (BYU); (Juab Co.) 1 ♂, same host, Callao, 12-VIII-1953, Beck, Coffey, Killpack (BYU); (Kane Co.) 5 ♂, 5 ♀, ex *Peromyscus truei* (182), NAV-KAI, 2-XII-1971 (BYU); 2 ♀, ex *Peromyscus crinitus* (228), same location, 11-XII-1971 (BYU); (Millard Co.) 2 ♂, 1 ♀, ex *Peromyscus maniculatus*, Fillmore, 11-VII-1952, Killpack and Coffey (BYU); (Piute Co.) 1 ♀, same host, Marysvale, 27-VI-1952, Killpack and Beck (BYU); (Rich Co.) 1 ♀, same host, Monte Cristo R.S., 24-VI-1953, D. E. Beck; (San Juan Co.) 1 ♂, ex *Peromyscus* sp., VII-1946; (Tooele Co.) 1 ♂, ex *Peromyscus maniculatus*, Dugway Proving Ground (39), 2-VIII-1951; (Utah Co.) 1 ♂, same host, Goshen Springs, 10-IX-1965, W. J. Despain (BYU); (Uintah Co.) 1 ♂, 1 ♀, same host, Jensen, 9-VI-1953, D. E. Beck (BYU); (Wasatch Co.) 2 ♀, same host, Soapstone R.S., 31-VII-1948, Mulaik (BYU); 1 ♀, same host, Wallsburg, 2-VII-1953, D. E. Beck (BYU) ex *Peromyscus maniculatus osgoodi*, 1 ♂, 2 ♀, Strawberry Valley, 11-VI-64, K. B. Cox (BYU); (Washington Co.) 2 ♀, ex *Peromyscus eremicus*, Grafton, 17-XII-1950. WYOMING: (Big Horn Co.) 1 ♀, ex *Peromyscus maniculatus* (B-2762), 13 km NW Greybull, 7-VI-1940; (Green River Co.) 1 ♂, 1 ♀, ex *Peromyscus maniculatus* (G-862), 31.6 km NW Green River, 1908 m, 28-VI-1949; (Lincoln Co.) 1 ♀, ex *Peromyscus maniculatus*, Cumberland, 23-VII-1955; (Park Co.) 1 ♂, 1 ♀, ex *Peromyscus maniculatus* (C-2846-5), Yellowstone National Park, Old Faithful Lodge, 22-V-1940; 1 ♂ (Finger resembles both *terinus* and *campestris*), ex

Peromyscus maniculatus (G-998), 41.7 km NW Cody, Shoshone National Forest, 2431 m (pine, cedar), 11-VIII-1949; (Sweetwater Co.) 1 ♀, ex *Peromyscus boylii* (B-1642), 17-VIII-1938; (Weston Co.) 1 ♂ (Finger resembles both *terinus* and *campestris*), ex *Peromyscus maniculatus* (F-848), 10 km N Newcastle, 1385 m (pine bluffs), 26-V-1949.

HOST SYNONYMY.—*Tamiasciurus douglasi albolimbatus* = *Tamiasciurus hudsonicus albolimbatus*.

Callistopsyllus terinus deuterus Jordan,
new combination

Figs. 1, 3, 6, 8, 11, 14, 36, 97

Callistopsyllus deuterus Jordan 1937:266; Hubbard 1940:37(4); Auguston 1942a:140; Auguston, 1942b:150; Jellison and Good, 1942:26; Ewing and Fox, 1943:111; Hubbard 1943:1-12; Hubbard 1947:283; Hubbard 1949:126; Jellison, Locker, and Bacon 1953:17; Hopkins and Rothschild 1962:358; Beck 1966:76; Beck and Allred 1966:13; Stark and Kinney 1969:287-294; Lewis 1974:147-167; Nelson and Smith 1976:51-61.

TYPE HOST.—*Peromyscus* sp.

TYPE LOCALITY.—Big Bear Lake, California.

TYPE SPECIMENS.—United States National Museum, Washington, D.C.

DIAGNOSIS.—MALE: Finger triangular; broad toward base with a narrow, round apex. Anterior margin convex with a rounded angle just above base. In *terinus* and *campestris* this angle is at base and is sharper. Caudal margin of finger of *deuterus* sometimes convex in apical half. Caudal margin of distal arm of sternum IX with rounded angle about midway, making apex appear narrower than in *terinus* or *campestris*. Small notches, thick bristles, and sharper angles found midway along the caudal border of distal arm of sternum IX of few specimens of *terinus* are not present in *deuterus* specimens available for examination. Apex of distal arm narrower and longer than either *terinus* or *campestris*, especially *campestris*.

FEMALE: Characters are not sufficiently distinctive to separate *deuterus* from *campestris* or *terinus*.

DISTRIBUTION.—ARIZONA: Yavapai County. CALIFORNIA: Fresno, Mariposa, Mono, Siskiyou, and Tuolumne counties. COLORADO: Montezuma County. MEXICO: Baja Califor-

nia. NEVADA: Nye County. OREGON: Jefferson County.

MATERIAL EXAMINED.—ARIZONA: (Yavapai Co.) 1 ♂, ex *Peromyscus truei* (B-708), 16.7 km N Prescott, 5-IV-1949 (The male is definitely *deuterus*, but other Arizona males are *terinus* (q.v.). The females from Yavapai Co. may be either *terinus* or *deuterus*.); 1 ♀, ex *Peromyscus truei* (B-717), 8.3 km N Prescott, 1662 m, 7-IV-1949; 1 ♀, ex *Peromyscus* sp. (A-301), 22-IV-1938. BAJA CALIFORNIA: 1 ♂, 1 ♀, ex *Peromyscus truei*, 1.6 km S. El Condor Hwy #2, 31-XII-1962, W. J. Wrenn (Traub Collection). CALIFORNIA: (Fresno Co.) 1 ♀, ex *Eutamias speciosus* (16097), Huntington Lake, 9-VI-1979; 1 ♀, ex *Peromyscus maniculatus* (16099), Huntington Lake (Bureau Vector Control, CA); (Mariposa Co.) 1 ♂, ex *Peromyscus* sp., Jct. Yosemite Creek Trail & Tioga Rd., Yosemite National Park, 2215 m, 2-VI-1959; (Mono Co.) 1 ♂, ex *Peromyscus maniculatus*, Tioga Pass Resort, Jct. Tioga Rd. & Saddle Bag Lake Rd., Inyo National Forest, 3077 m, 8-IX-1961; (Tuolumne Co.) 1 ♂, ex *Peromyscus maniculatus*, Tuolumne Meadows, Yosemite National Park, 2615 m, (Plague Lab); County not given: 1 ♂ (16478), locality not given (Bureau Vector Control, CA). NEVADA: (Nye Co.) 1 ♀, ex *Peromyscus crinitus*, Mercury (AEC-NRTS), 9-XII-1961 (BYU). OREGON: (Jefferson Co.) (See *C. t.* material examined).

Callistopsyllus terinus campestris Holland,
new combination

Figs. 2, 5, 9, 12, 14, 95

Callistopsyllus campestris Holland, 1949b:98; Hopkins and Rothschild, 1962:358; Senger, 1966:106; Jellison and Senger, 1973:19; Lewis, 1974:147-167.

TYPE HOST.—*Peromyscus maniculatus osgoodi*.

TYPE LOCALITY.—Medicine Hat, Alberta, Canada.

TYPE SPECIMENS.—Canadian National Collection, Ottawa, Canada.

DIAGNOSIS.—MALE: Finger somewhat rectangular or oval, depending upon specimen. Narrower basally and broader distally than in either *terinus* or *deuterus*; sides subparallel. Angle of anterior border at base variable; its outline is between that of *terinus*, which is acute and at the base, and *deuterus*, which is

rounded and above the base. Distal arm of sternum IX gradually curved along curved margin; apex broadly rounded—more so than in *terinus* or *deuterus*. Bristles along caudal border of distal arm of sternum IX about as numerous (13–14) as *terinus*.

FEMALE: Characters are not sufficiently distinctive to separate *terinus* from *deuterus* or *campestris*.

DISTRIBUTION.—ALBERTA, SASKATCHEWAN. MONTANA: Big Horn, Custer, and Park counties. WYOMING: Teton County.

MATERIAL EXAMINED.—ALBERTA: 1 ♂, 1 ♀, ex *Peromyscus maniculatus osgoodi*, Medicine Hat, 6-VI-40 (Holland). SASKATCHEWAN: 1 ♂ ex *P. m. osgoodi*, Estevan, 28-VI-42 (Holland). MONTANA: (Custer Co.), 1 ♀, ex *Dipodomys ordii* (C-2574), 45 km S of Miles City, 22-III-1940; 1 ♂, ex *Peromyscus maniculatus* (C-2581-5), 28-III-1940; 1 ♀, ex *Peromyscus maniculatus* (C-2589-S), 29-III-1940; 2 ♂, ex *Peromyscus maniculatus* (C-2599), 42 km SW of Miles City, 30-III-1940; (Park City) 2 ♂, 1 ♀, ex *Peromyscus* sp., (D-667), 29-VI-1938; (Prairie Co.) 1 ♂, 1 ♀, ex *Peromyscus maniculatus* (E-760), 8 km E Terry (sage 677 m) 26-V-1949.

Conorhinopsylla Stewart

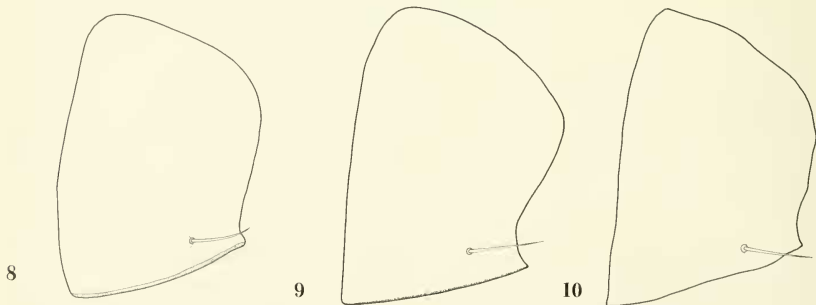
Conorhinopsylla Stewart 1930:178; Fox 1940:29, 41; Jellison and Good 1942:42; Ewing and Fox 1943:73; Jellison 1945:109–111; Hubbard 1947:274,293; Holland 1949b:55, 101; Traub and Tipton 1951:267–268; Jellison, Locker, and Bacon 1953:37; Hopkins 1957:64–87; Stark 1959:97; Hopkins and Rothschild 1962:359; Jellison and Glesne 1967:67; Lewis 1974:147–167.

DIAGNOSIS.—*Conorhinopsylla* is the only genus in the subfamily in which the anteroventral angle of the head is acuminate, there is no clypeal tubercle, there are two rows of bristles on the terga, and the pleural arch is vestigial. The eye is vestigial as in *Megarhroglossus*, but in the latter genus there are no spiniform bristles on the genitalia. Male sternum VIII is greatly modified and bears spiniform bristles on the distal portion.

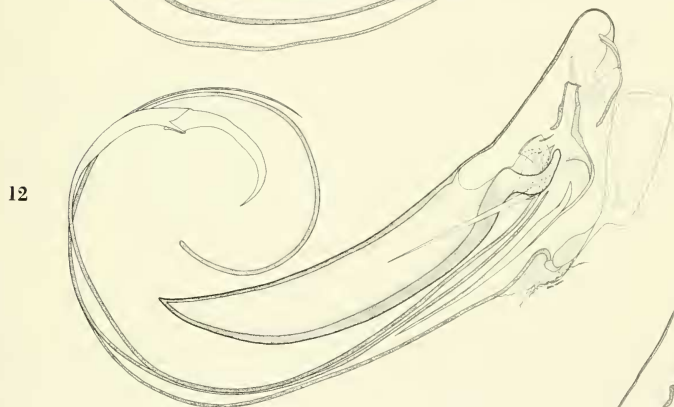
DESCRIPTION.—HEAD: Anterior margin of head slightly convex, frontal tubercle absent, oral angle a nipplelike protuberance. Genal process with undulating anterior margin, apex subtruncate to truncate. Two prominent ocular bristles near anterior margin of genal process. Irregular row of 5 preocular bristles. Eye vestigial, triangular, lightly pigmented. Trabeculum centralis (area communis) absent. Antennal fossae do not extend to vertex to form interantennal suture; anterior margin with 3–4 small bristles; posterior margin with 4–5 small submarginal bristles. First and second antennal segments with several small bristles plus 5–6 small bristles. Occipital area with two large bristles; placoids on both frontal and occipital areas. Maxillary palp 4-segmented. Labial palp 5–8 segmented, extends beyond foretrochanter, apex asymmetrical. Genal comb absent.

THORAX: Pronotal comb with 12 very broad teeth. Pleural arch absent. Pleural rod very thin and elongate.

LEGS: Sexual dimorphism in chaetotaxy of hind legs pronounced in *S. stanfordi*, less so



Figs. 8–10. Males, sternum VIII: 8, *Callistopsylla terinus deuterus*; 9, *C. t. campestris*; 10, *C. t. terinus*.



Figs. 11-13. Males, aedeagus; 11, *Callistopsyllus terinus deuterus*; 12, *C. t. campestris*; 13, *C. t. terinus*.

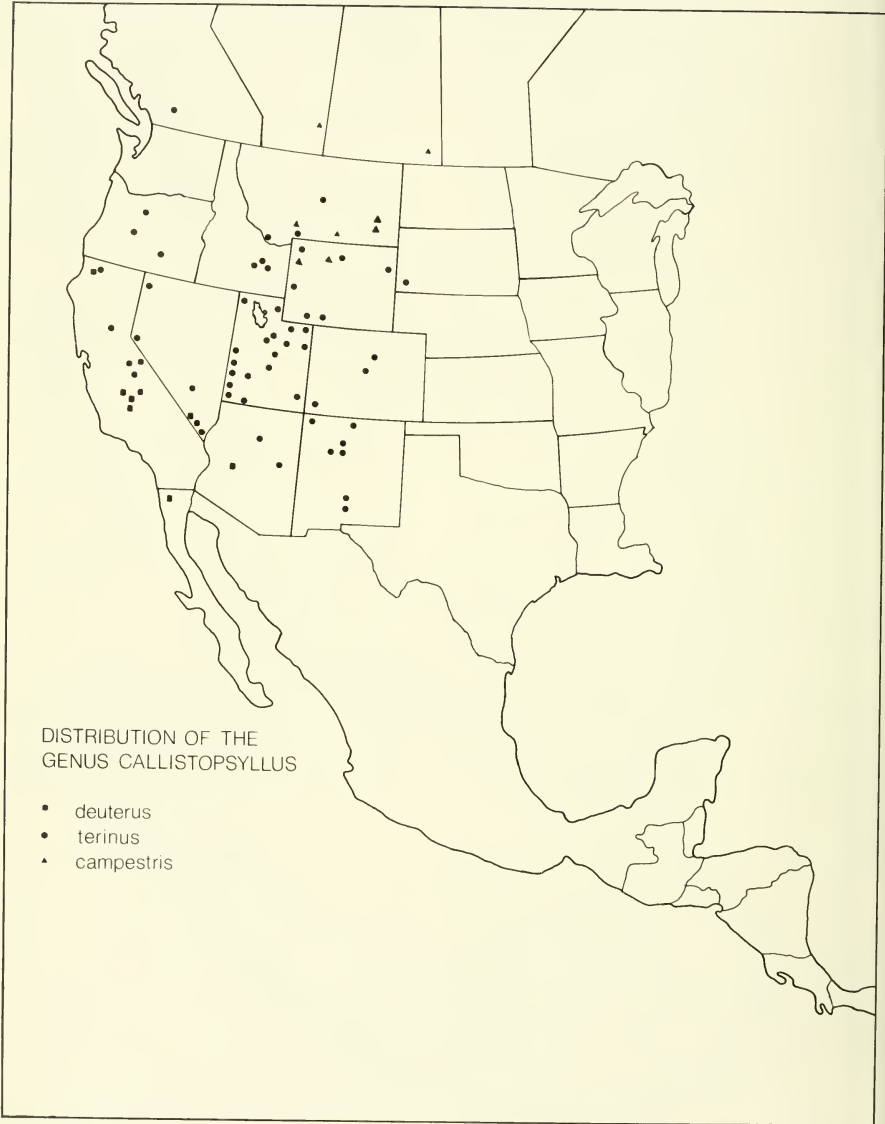


Fig. 14. Distribution of *Callistopsyllus terinus* ssp.

in *S. nidicola*. Four pairs of lateral plantar bristles and proximal median pair of bristles on fifth tarsal segments of all legs.

ABDOMEN: Abdominal tergal spinelets variable, generally terga I-III with 2 spinelets per side, tergum IV with one per side, terga V-VII without spinelets; each tergum with 1 row of bristles usually consisting of 5 to 7 long bristles intermixed with several minute bristles, ventrad most long bristle shifted anterod on main row of bristles. Lateral bristles on abdominal sterna variable, usually in row of 2-4 per side. Number of antepygidial bristles 2 or 3 depending on species: with 3, centermost longest, remaining 2 vary from minute to small in males or from two-thirds to three-fourths length of middle bristle in fe-

males; with 2, dorsal bristle longest, ventral bristle varies from minute to subequal in males, from three-fourths to subequal in length to dorsal bristle in females.

Modified segments—Male: Fixed process of clasper greatly enlarged, modified in *C. stanfordi*, less so in *C. nidicola*. Sternum VIII reduced, with apical or subapical spiniform bristles. Sternum IX reduced, with apical and subapical bristles. Details of aedeagal morphology vary according to species.

Modified segments—Female: Caudal margin of sternum VII convex. Bulga of spermatheca somewhat beanlike, hilla lacking striations, otherwise lacking sharp line of demarcation between bulga and hilla.

Key to The Species of *Conorhinopsylla* Males

1. Apical portion of distal arm of sternum VIII with 8 or more spiniform bristles (Fig. 19); movable process of clasper extends far beyond apex of immovable process of clasper (Fig. 23) *nidicola*
- Apical portion of distal arm of sternum VIII with 5 or fewer spiniform bristles (Fig. 18); movable process of clasper does not extend far beyond immovable process of clasper (Fig. 22) *stanfordi*

TABLE 3. Distribution of species of *Conorhinopsylla*.

HOST SPECIES	<i>C. nidicola</i>	<i>C. stanfordi</i>
Illinois		X
Indiana		X
Iowa		X
Kansas	X	
Maryland		X
Michigan		X
New York		X
Ohio		X
Pennsylvania		X
Utah		X
Wisconsin		X
Ontario		X

TABLE 4. Host associations of the genus *Conorhinopsylla*.

HOST SPECIES	<i>C. nidicola</i>	<i>C. stanfordi</i>
<i>Glaucomys</i> sp.		X
<i>Glaucomys sabrinus</i>		X
<i>Glaucomys sabrinus mucrotis</i>		X
<i>Glaucomys volans</i>		X
<i>Glaucomys volans colans</i>		X
<i>Neotoma</i> sp.	X	
<i>Neotoma floridana</i>	X	
<i>Neotoma floridana osagensis</i>	X	
<i>Peromyscus</i> sp.		X
<i>Peromyscus maniculatus</i>	X	
<i>Procyon lotor</i>		X
<i>Sciurus carolinensis</i>		X
<i>Sciurus niger</i>		X
<i>Spermophilus townsendi</i>		X
<i>Tamiasciurus hudsonicus</i>		X
<i>Tamiasciurus hudsonicus loquax</i>		X

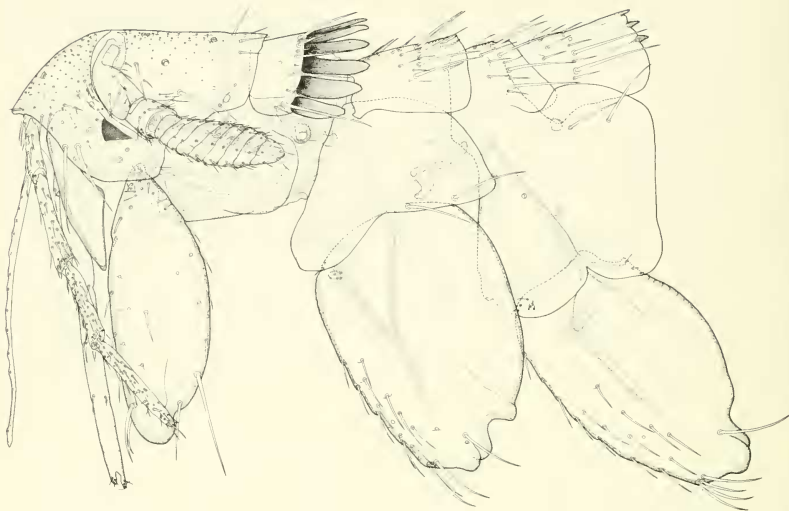


Fig. 15. *Conorhinopsylla stanfordi*; Male, head and thorax including coxae.

Conorhinopsylla stanfordi Stewart

Figs. 15-18, 20, 22, 24, 26, 31

Conorhinopsylla stanfordi Stewart 1930:178-179; Jordan 1933:267; Fox 1940:41; Hubbard 1940:37(4); Fuller 1942:137; Jellison and Good 1942:42; Ewing and Fox 1943:74; Fuller 1943:5; Jameson 1943:177; Stanford 1944:174; Jellison 1945:109; Hubbard 1947:102; Jellison, Locker, and Bacon 1953:37; Benton 1955:139-140; Burbutis 1956:782; Layne 1958:162; Geary 1959:355; Stark 1959:97; Benton and Cerwonka 1960:383-391; Hopkins and Rothschild 1962:360; Benton and Smiley 1963:4; Osgood 1964:29-33; Jellison and Glesne 1967:65-66; Benton 1967:150-160; Humphreys 1967:188; Whitaker and Corthum 1967:432; Holland and Benton 1968:256; Tipton and Saunders 1971:18; Amin 1973:110-111; Jenkins and Grundmann 1973:76-86; Haas and Wilson 1973:302-314; Lewis 1974:147-167; Jackson and Defoliart 1976:351-356.

TYPE HOST.—*Tamiasciurus hudsonicus*.

TYPE LOCALITY.—Ithaca, Tompkins Co., New York.

TYPE SPECIMENS.—Collection of M. A. Stewart.

DIAGNOSIS.—*Conorhinopsylla stanfordi* may be distinguished from *C. nidicola*, the only other species in the genus, on the basis of the following set of characters; eye vesti-

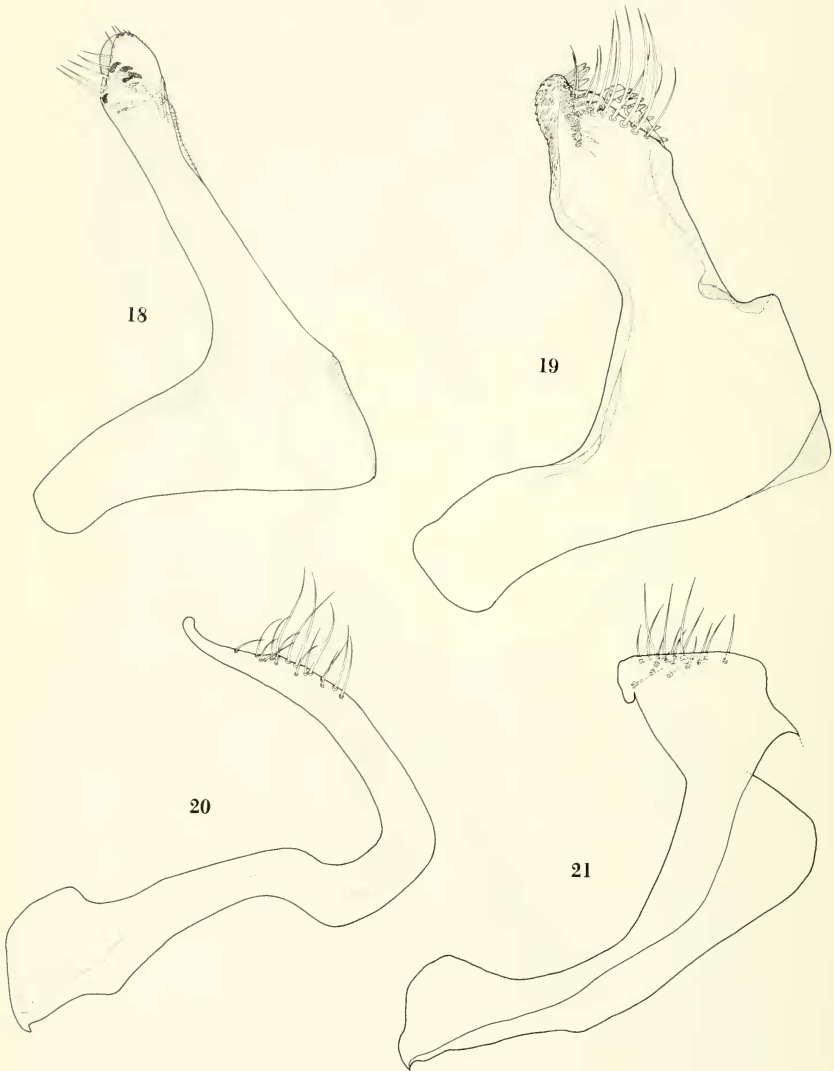
gial but sufficiently pigmented to be readily discernible; labial palp with 5-6 segments; in the male the metatibia and first two metatarsal segments with long prominent bristles; clasper projected caudally, fixed and movable processes of clasper about same size; distal arm of sternum VIII narrow but subapical area slightly enlarged and with 4-5 spiniform bristles; the distal arm of sternum IX is narrow, tapers apically and bears several long subapical bristles.

DISTRIBUTION.—ILLINOIS: Madison County. INDIANA: Vigo County. IOWA: Dubuque County. MARYLAND: Frederick County. MICHIGAN: Clinton County. NEW YORK: Otesago and Ulster counties. OHIO: Athens and Jackson counties. PENNSYLVANIA: Bradford and Erie counties. UTAH: Sevier County. WISCONSIN: Adams and Iowa counties. CANADA: Ontario.

MATERIAL EXAMINED.—MARYLAND: (Frederick Co.) 1 ♂ ex *Tamiasciurus hudsonicus loquax* (nest), 1.5 miles N Wolfsville, 28-XI to 3-XII-1970, Traub and Schlitter; 1 ♀ ex *Glaucomyz v. colans*, same collection data;



Figs. 16-17. *Conorhinopsylla stanfordi*, metathoracic legs: 16, female; 17, male.



Figs. 18-21. Males, sternum VIII; 18, *Conorhinopsylla stanfordi*; 19, *C. nidicola*; 20-31. sternum IX; 20, *C. stan-*
fordi; 21, *C. nidicola*.

1 ♀ ex *Sciurus carolinensis*, Oxon Hill, 5-XII-1923, E. Chapin. OHIO: (Athens Co.) 1 ♂ ex nest of flying squirrel, Waterloo Twp., 10-X-1964, H. G. Humphreys. NEW YORK: (Chautauqua Co.) 1 ♂ ex nest of *Glaucomys volans*, 1 mile S Fredonia; (Otesga Co.) 1 ♂, 1 ♀ ex *Glaucomys volans*, Middlefield Twp., 6-XII-1956, P. Connor.

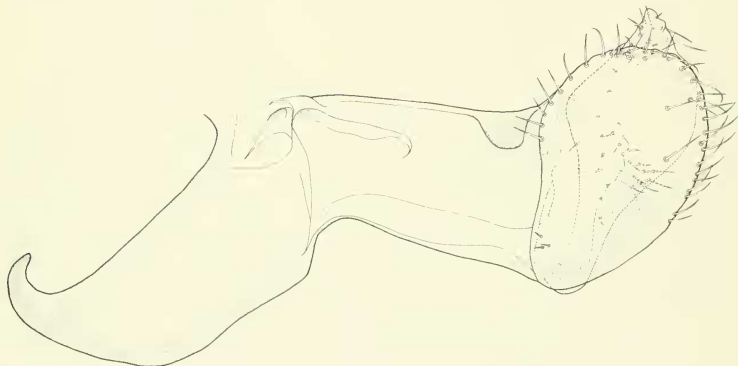
DISCUSSION.—Stanford (1944) reported *C. stanfordi* from Utah but this record is very likely in error. If so, then it can be said that *C. stanfordi* occurs on arboreal squirrels east of the Mississippi River.

Conorhinopsylla nidicola (Jellison)

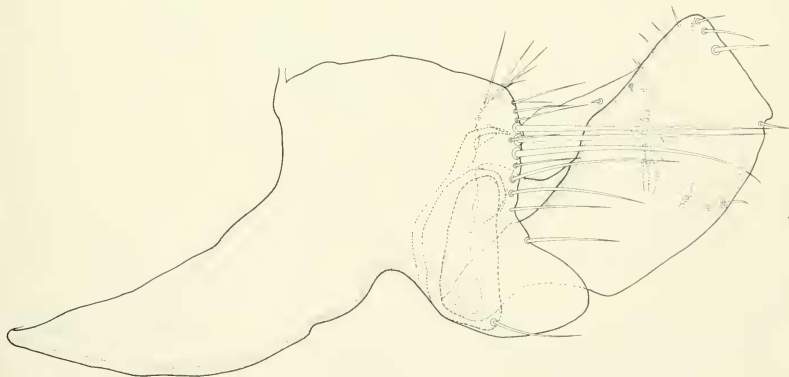
Figs. 19, 21, 23, 25, 27, 31

Conorhinopsylla nidicola Jellison 1945:109; Holland 1949b:102; Jellison, Locker, and Bacon 1953:37; Rainey 1956:535-646; Poorbaugh and Gier 1961:201; Hopkins and Rothschild 1962:362; Jellison and Glesne 1967:65; Lewis 1974:147-167.

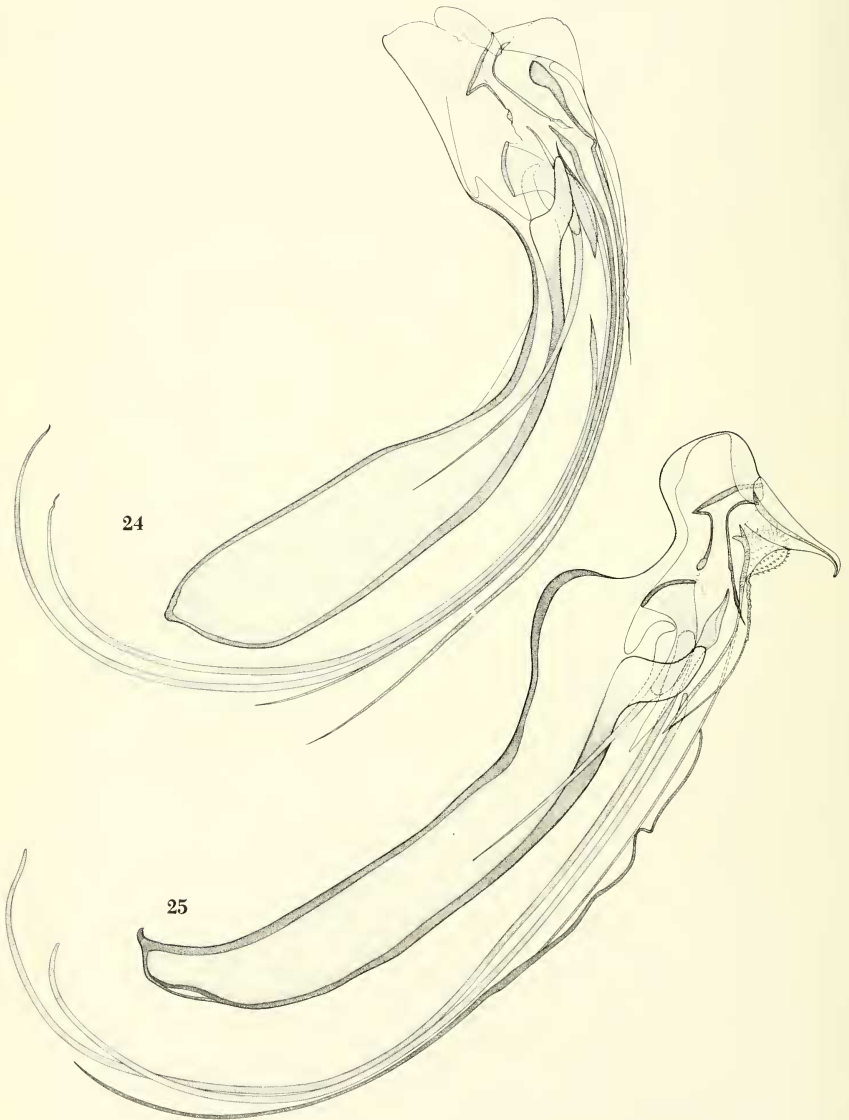
DIAGNOSIS.—*Conorhinopsylla nidicola* may be characterized as follows: eye vestigial and not readily discernible; labial palp with 8 or more segments; in the male there is no comb-like row of bristles on the hind tibia, and the tarsal bristles are not so long as in *C. stan-*



22



23



Figs. 24-25. Males, aedeagus; 24, *Conorhinopsylla stanfordi*; 25, *C. nidocola*.

fordi; there is no caudal projection of the male clasper and the movable process of the clasper extends dorsally far beyond the fixed process of the clasper; the distal arm of sternum VIII is broad and with 8-10 apical and subapical bristles; the distal arm of sternum IX is broad and with a truncate apex and several marginal and submarginal bristles.

Female characters are not sufficiently distinctive to be diagnostic.

TYPE HOST.—*Neotoma floridana*.

TYPE LOCALITY.—Lawrence, Douglas Co., Kansas.

TYPE SPECIMENS.—SNOW Collection, University of Kansas and U.S. National Museum.

26



27



28



29



30



Figs. 26-30. Females, sternum VIII; 26, *Conorhinopsylla stanfordi*; 27, *C. nidicola*; 28, *Stenistomera hubbardi*; 29, *S. macrodactyla*; 30, *S. alpina*.

DISTRIBUTION.— KANSAS: Douglas, Riley, and Republic counties.

MATERIAL EXAMINED.— KANSAS: (Douglas Co.), 3 ♂, 3 ♀ (paratypes) ex nest of *Neotoma* sp., Lawrence, 11-XI-1944, R. H. Beamer;

2 ♂ ex *Neotoma* sp., 1959, A. El-Wailly; 1 ♀ ex *Neotoma floridana*, 1959, A. El-Wailly; 1 ♀ ex nest of *Neotoma* sp., Lawrence, 10-V-1948, C. E. Hopla; 1 ♀ ex nest of *Neotoma floridana osagenis*, Lawrence, 13-XII-1947,

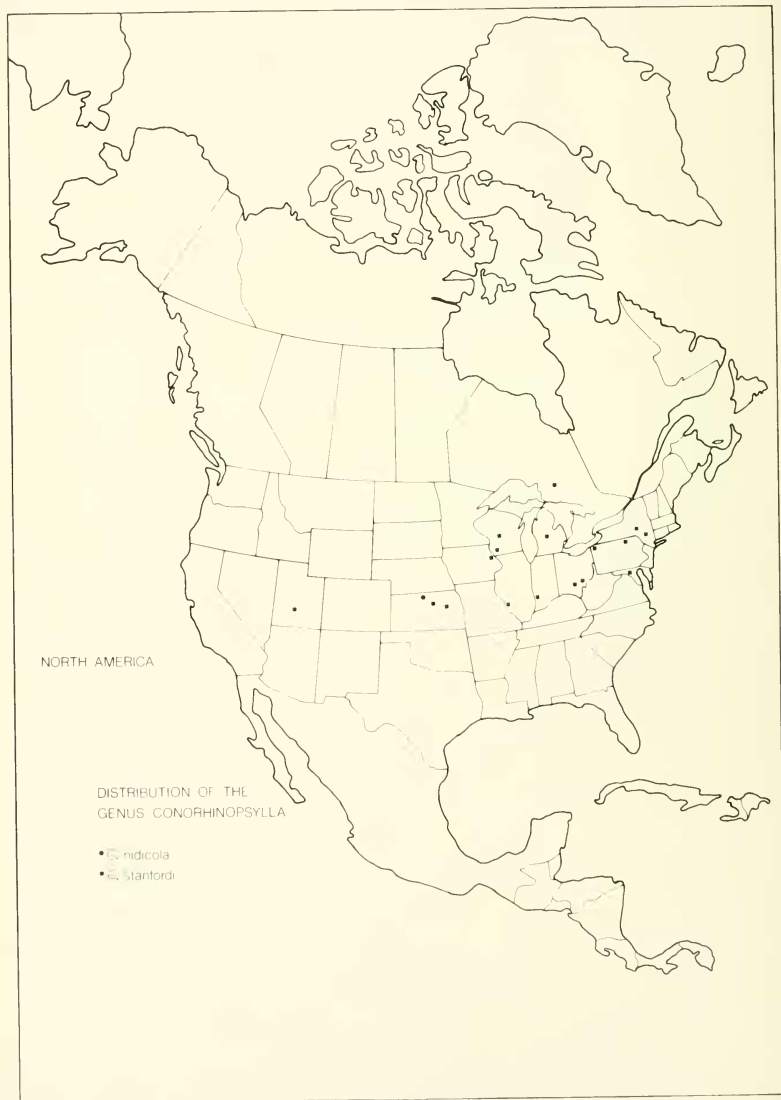


Fig. 31. Distribution of *Conorhinopsylla nidicola* and *C. stanfordi*.

C. E. Hopla; 1 ♂ ex *Neotoma floridana*, Lawrence, 3-XII-1949, C. E. Hopla; 1 ♂, 1 ♀ ex nest of *Neotoma* sp., Lawrence, 30-IX-1948, C. E. Hopla; 1 ♀ ex nest of *Neotoma floridana osagensis*, 22-XI-1952, D. A. Crossley.

DISCUSSION.—*Conorhinopsylla nidicola* is associated with *Neotoma floridana* west of the Mississippi River in Kansas.

Megarthroglossus Jordan & Rothschild

Megarthroglossus Jordan and Rothschild 1915:46 (Type species: *Megarthroglossus procus* Jordan and Rothschild, 1915); Ewing 1929:162; Jellison and Good, 1942:83; Ewing and Fox, 1943:113; Hubbard 1947:296; Holland 1949:89; Eads 1950:53-54; Traub and Tipton 1951:267-278; Jellison, Locker, and Bacon 1953:104; Traub 1953:77-85; Morlan 1954:446; Mendez 1956:159-192; Hopkins 1957:64-67; Finley 1958:213-552; Parker and Howell 1959:597-604; Stark 1959:98; Hopkins and Rothschild 1962:365; Holland 1965:1052; Jellison and Glesne 1967:16; Stark and Kinney 1969:287-294; Mendez and Haas 1972:285-288; Lewis 1974:155; Nelson and Smith 1976:54; Egoscue 1976:475-480.

The Nearctic genus *Megarthroglossus* was established by Jordan and Rothschild in 1915 with *Megarthroglossus procus* as the type species. Baker (1895) described *Pulex longispinus*, which was subsequently placed in the genus *Ceratophyllus* by Wagner (1898) and in the genus *Megarthroglossus* by Jordan and Rothschild (1915). Mendez (1956) revised

Megarthroglossus and included 12 species and 1 subspecies. Since this revision an additional 3 species have been described: *M. cavernicolus* Mendez and Haas, 1972; *M. wilsoni* Mendez and Haas, 1973; and *M. weaveri* Eads and Campos, 1977. *Megarthroglossus muiri* was reduced to a subspecies of *M. procus* by Hopkins and Rothschild (1962), and we have chosen to retain the two subspecies as valid taxa even though they are very similar morphologically. In this paper *M. pygmaeus* (Wagner 1936) is considered a junior synonym of *M. spenceri*, and *M. divisus exsecutus* is reduced to a junior synonym of *M. divisus*. As a result of these taxonomic changes, the genus *Megarthroglossus* includes 13 known taxa, of which one is a subspecies.

The genus *Megarthroglossus* has been collected in a variety of habitats and from many hosts (Table 6). Species of the genus *Neotoma* appear to be preferred hosts. Species of the genera *Eutamias*, *Glaucomys*, *Ochotona*, *Peromyscus*, and *Tamiasciurus* are considered to be secondary hosts.

The geographical distribution of species and subspecies of *Megarthroglossus* is given in Table 5 and Figures 100, 101. Specimens have been collected from Texas to Canada and from California east to Nebraska.

DIAGNOSIS.—*Megarthroglossus* may be separated from *Callistopsyllus* and *Anomiop-*

TABLE 5. Distribution of species and subspecies of *Megarthroglossus*.

TAXA	Arizona	California	Colorado	Idaho	Montana	Nebraska	Nevada	New Mexico	Oregon	Texas	Utah	Washington	Wyoming	Alberta	British Columbia
<i>M. becki</i>											X				
<i>M. bisetis</i>								X	X	X					
<i>M. cavernicolus</i>								X							
<i>M. divisus</i>	X	X	X	X	X	X		X	X	X	X		X	X	X
<i>M. jamesoni</i>		X					X								
<i>M. procus muiri</i>		X													
<i>M. procus procus</i>		X	X			X	X		X		X	X	X		X
<i>M. sicamus</i>															X
<i>M. sierrae</i>	X														
<i>M. smitti</i>							X				X				
<i>M. spenceri</i>		X													X
<i>M. weaveri</i>			X												
<i>M. wilsoni</i>			X					X							

falx. Tentorial arch present, well developed, located anterior to eye.

THORAX: Prosternum with dorsal angulate to subangulate inflexion at posterior one-third of ventral margin. Pronotal comb present, 6 to 8 blunt, broad spines per side. Thoracic link plates II and III well developed. Mesonotum with 3 distinct rows of bristles. Mesepimeron usually with 3 long bristles, anteriormost close to or directly over pleural rod. Mesepisternum with row of small bristles, extending from dorsal angle to mid-segment. Metanotum with one row bristles. Lateral metanotal area not complete, sclerites partially fused. Metepisternum partly fused with metasternum and metepimeron to metanotum; setation sparse, normally with 3 long bristles, one near caudal margin, 2 in proximity to pleural rod.

LEGS: Profemur with 2-3 lateral bristles on mesal surface. Metatarsus II with 1-2 long, lateral, apical bristle(s), extending from one-half to full length of metatarsus V. Metatarsus V with 4 pairs lateral plantar bristles, 1 basoventral pair.

ABDOMEN: Abdominal tergal spinelets variable, generally tergum I with 1-2, tergum II with one per side. Abdominal terga with one

Table 6 continued.

<i>Ochotona</i> sp.						X	
<i>Ochotona princeps</i>	X	X	X		X		X
<i>Ochotona schisticeps</i>				X			
<i>Ochotona nutri</i>						X	
<i>Peromyscus</i> sp.		X	X				X
<i>Peromyscus boylii</i>		X	X		X		
<i>Peromyscus crinitus</i>							
<i>pergracilis</i>						X	
<i>Peromyscus leucopus</i>		X	X				
<i>Peromyscus</i>							
<i>maniculatus</i>			X		X		X
<i>Peromyscus m. rubidus</i>					X		
<i>Peromyscus m. sonoriensis</i>			X			X	
<i>Peromyscus nasutus</i>		X					
<i>Peromyscus truei</i>		X	X		X		
<i>Peromyscus t. nevadensis</i>			X				X
<i>Rattus norvegicus</i>					X		
<i>Sigmodon hispidus</i>		X					
<i>Sorex palustris</i>							
<i>navigator</i>				X			
<i>Spilogale</i> sp.						X	
<i>Spilogale gracilis saxatilis</i>							X
<i>Sylvilagus nuttallii</i>		X					
<i>Tamiasciurus</i> sp. and nest			X		X		
<i>Tamiasciurus hudsonicus</i>		X	X				
<i>Tamiasciurus h. douglasi</i>			X	X	X		
<i>Tamiasciurus h. albolimbatus</i>					X	X	
<i>Tamiasciurus h. fremonti</i>			X				
<i>Tamiasciurus h. streatori</i>			X				
<i>Thomomys bottae</i>	X						
<i>Thomomys talpoides</i>		X					
"Weasle"			X				

row of 5-7 long bristles intermixed with several minute bristles, ventralmost long bristle shifted anterad of main row of bristle. Lateral bristles on abdominal sterna variable, usually in row of 2-4 per side. Antepygidial bristles 2-3 depending on species; those with 3, centermost longest with upper and lower varying from minute to small (in males) or from two-thirds to three-fourths length of center bristle (in females); those with 2, uppermost longest with lower varying from minute to medium (in males), three-fourths to almost as long as upper (in females).

Modified segments—Male: Fixed process of clasper with hump (inner fovea), one-half distance from acetabular area to apex of process, may be marginal or submarginal. Caudal margin of fixed process with 2-3 (usually 3) long, stout bristles dorsad of acetabular area, one bristle ventrad to acetabular area. Shape of caudal margin of sternum VIII variable, diagnostic in some species, normally ensheathing distal one-half to two-thirds of distal arm of sternum IX. Proximal arm of sternum IX expanded, with or without cephalad-directed projection. Shape of distal arm of sternum IX variable, diagnostically distinct in some species. Aedeagal apodeme blade shaped, tapering at neck, without proximal or apical spur. Dorsal margin either straight, with slight undulation, or possessing prominent hump in proximity of crescent sclerite. Median dorsal lobe acuminate, truncate, or broadly convex. Crochet of aedeagus large, conspicuous; caudal border variable; apical process hooklike, rounded, or absent. Apex of sclerotized inner tube truncate, with distinct dorsolateral projection. Satellite sclerite

closely associated with sclerotize inner tube. Penis rods uncoiled, extending slightly dorsad of apex of aedeagal apodeme.

Modified segments—Female: Caudal margin of sternum VII undulate, sinus present or absent on ventrolateral aspect. Anal stylet variable in length, setation varies according to species. Spermatheca variable, bulga may be elongate or compressed. Hilla bent sharply or gently curved dorsad, distal end varying from narrowly convex or broadly convex to subtruncate.

The genus *Megarthroglossus* is a complex group of closely related species with many similar morphological features. Often the description of one species applies equally well to several other species. For this reason, a detailed description of all species is not given but, instead, a short, narrative diagnosis for each species is presented.

Keys to both males and females (except for the female of *M. sicamus*) are given. It should be emphasized that overlap between species was observed for several taxonomic characters. Characters used in the key include measurements whenever possible with the intent of excluding such ambiguous terms as *prominent*, *not deeply indented*, and *narrow*, to mention but a few. In addition, the key to the females may not be entirely satisfactory, but it is intended to fill a void because current literature does not include keys to the females. *Megarthroglossus sicamus* is not included in the key because specimens were not available. If *M. sicamus* were included in the key, it would be placed near *M. jamesoni* and *M. cavernicolus*.

Key to Species of *Megarthroglossus* (Males)

- | | | |
|-------|---|----------------|
| 1. | Height of hump on dorsal margin of aedeagus greater than 10 microns | 2 |
| — | Hump of dorsal margin of aedeagus absent, or, if present, height less than 10 microns | 6 |
| 2(1). | Posterior margin of sternum VIII evenly convex; inner fovea of immovable process more than 60 microns below dorsal margin; hump on dorsal margin of aedeagus exceeds 30 microns | <i>sicamus</i> |
| — | Posterior margin of sternum VIII sinuate; inner foveae of immovable process less than 60 microns below dorsal margin (Fig. 32); hump on dorsal margin of aedeagus variable | 3 |

- 3(2). Anterior margin of finger of clasper with angular denticle; hump on dorsal margin of aedeagus exceeds 20 microns; inner fovea of immovable process exceeds 50 microns below dorsal margin; ventrolateral lobe of sternum VIII evenly convex *spenceri*
- Anterior margin of finger of clasper without angular denticle; inner fovea of immovable process less than 50 microns below dorsal margin; ventrolateral lobe of sternum VIII variable 4
- 4(3). Median dorsal lobe of aedeagus reduced to short, blunt lobe; posterior margin of sternum VIII sinuate, with truncate to subtruncate ventrolateral lobe 5
- Median dorsal lobe of aedeagus long, with curved apex; posterior margin of sternum VIII undulate, with a short subacuminate lobe *smitti*
- 5(4). Hump on dorsal margin of aedeagus less than 20 microns; length of labial palp segment V less than 220 microns; inner fovea of immovable process exceeds 30 microns, marginal; ventrolateral lobe of sternum VIII subtruncate *sicrae*
- Hump on dorsal margin of aedeagus exceeds 30 microns; length of labial palp segment V exceeds 220 microns; inner fovea of immovable process exceeds 30 microns, submarginal; ventrolateral lobe of sternum VIII truncate *jamesoui*
- 6(1). Ventrolateral lobe of sternum VIII long, fingerlike, curved ventrad; inner fovea of immovable process exceeds 50 microns, marginal *becki*
- Ventrolateral lobe of sternum VIII not fingerlike; posterior margin of sternum VIII variable; inner fovea of immovable process less than 50 microns, submarginal 7
- 7(6). Posterior margin of sternum VIII evenly convex; 2 or 3 antepygidial bristles 8
- Posterior margin of sternum VIII sinuate, with variable shaped ventrolateral lobe; 3 antepygidial bristles 9
- 8(7). Two or 3 antepygidial bristles per side; inner fovea of immovable process less than 35 microns; segment V of labial palp less than 220 microns in length; crochet spur exceeds 10 microns in length; finger of clasper less than 120 microns in length; metatarsal segment I less than 220 microns in length *bisetis*
- 2 antepygidial bristles per side; inner fovea of immovable process exceeds 35 microns; segment V of labial palp exceeds 220 microns in length; crochet spur less than 10 microns in length; finger of clasper exceeds 120 microns in length *wacveri*
- 9(7). Ventrolateral lobe of sternum VIII divided into upper convex lobe and lower acuminate lobe; crochet spur less than 10 microns in length 10
- Ventrolateral lobe of sternum VIII not divided; crochet spur exceeds 10 microns in length 11
- 10(9). Width of median dorsal lobe of aedeagus exceeds 20 microns; segment V of labial palp exceeds 140 microns in length; depth of sinus in sternum VIII less than 45 microns *procus procus*
- Width of median dorsal lobe of aedeagus less than 20 microns; segment V of labial palp less than 130 microns in length; depth of sinus in sternum VIII exceeds 45 microns *procus muiri*
- 11(9). Inner fovea of immovable process less than 20 microns below the dorsal margin; crochet spur less than 20 microns in length; sternum IX less than 150 microns in length *cavemicolus*

- Inner fovea of immovable process more than 25 microns from dorsal margin; crochet spur exceeds 30 microns in length; sternum IX exceeds 180 microns in length 12
- 12(11). Inner fovea of immovable process less than 20 microns in length; crochet spur less than 60 microns in length; segment V of labial palp more than 170 microns in length *divisus*
- Inner fovea of immovable process exceeds 40 microns in length; crochet spur exceeds 60 microns in length; segment V of labial palp less than 170 microns in length *wilsoni*

Key to Species of *Megarthroglossus* (Females)

- 1. Bulga of spermatheca compressed (i.e., appears to be withdrawn into itself (Fig. 86) 5
- Bulga of spermatheca not compressed (Fig. 84) 2
- 2(1). Posterior margin of sternum VII with sinus 3
- Posterior margin of sternum VII without sinus 4
- 3(2). With 3 antepygial bristles per side; segment V of labial palp less than 300 microns in length; hilla of spermatheca less than 40 microns in width (Fig. 94) .
spenceri
- With 2 antepygial bristles per side; segment V of labial palp exceeds 300 microns in length; hilla of spermatheca more than 40 microns in width *weaveri*
- 4(2). With 3 or 4 antepygial bristles per side; pronotal comb with 7-8 spines per side; segment V of labial palp less than 230 microns in length; hilla of spermatheca less than 40 microns in width *cavernicolus*
- With 3 antepygial bristles per side; pronotal comb with 8-9 spines per side; segment V of labial palp more than 270 microns in length; hilla of spermatheca more than 40 microns in width *jamesoni*
- 5(1). Posterior margin of sternum VII with sinus, more than 10 microns in depth (Fig. 33) 8
- Posterior margin of sternum VII usually without sinus but if present then less than 10 microns in depth 6
- 6(5). Distal portion of hilla of spermatheca more than 115 microns, more than 50 microns in width; metatarsal segment I more than 300 microns in length
sierrae
- Distal portion of hilla of spermatheca less than 114 microns, less than 50 microns in width; metatarsal segment I less than 290 microns in length 7
- 7(6). With 3 antepygial bristles; pronotal comb with 6 spines per side; spermathecal hilla ratio (vertical length: horizontal length) exceeds 1.50; spermathecal bulga ratio (width of bulga at point of greatest width; width of bulga at point of narrowest width) exceeds 1.50. (Fig. 34) *procus muiri*
- With 2-3 antepygial bristles; pronotal comb with 6-8 spines per side; spermathecal hilla ratio less than 1.20; spermathecal bulga ratio less than 1.40 *procus procus*
- 8(5). Hilla of spermatheca more than 40 microns in width; sternum VII sinus depth to width ratio less than 2.00; with 2 antepygial bristles per side; pronotal comb with 8 spines per side; spermathecal hilla ratio less than 1.10 with bulga ratio exceeds 1.50 *bisetis*

- Hilla of spermatheca less than 40 microns in width; sternum VII sinus depth to width ratio exceeds 2.00; antepygial bristles variable, 1-4 per side; pronotal comb spines variable, 6-8 per side; spermathecal hilla exceeds 1.10 with bulga ratio exceeds 1.70 (if hilla ratio less than 1.10, then bulga ratio less than 1.50) ... 9
- 9(8). Sternum VII sinus depth to width ratio exceeds 2.40; with 2-4 antepygial bristles per side; pronotal comb with 6-8 spines per side; segment V of labial palp exceeds 270 microns in length (average) 10
- Sternum VII sinus depth to width ratio less than 2.40; with 3 antepygial bristles per side; pronotal comb with 7-8 spines per side; segment V of labial palp less than 270 microns in length (average) 11
- 10(9). Sternum VII sinus ratio exceeds 4.00; spermathecal hilla ratio exceeds 1.20 and bulga ratio exceeds 1.80; pronotal comb with 8 spines per side *smi*
- Sternum VII sinus ratio less than 3.00; spermathecal hilla ratio less than 1.20 and bulga ratio less than 1.70; pronotal comb with 6-8 spines per side *divisus*
- 11(9). Pronotal comb with 8 spines per side; spermathecal hilla width exceeds 35 microns; segment V of labial palp more than 260 microns in length; spermathecal hilla ratio less than 1.10 and bulga ratio less than 1.50 *becki*
- Pronotal comb with 7 spines per side; spermathecal hilla width less than 35 microns; segment V of labial palp less than 260 microns in length; spermathecal hilla ratio exceeds 1.20 and bulga ratio exceeds 1.80 *wilsoni*

Mendez (1956) pointed out that many of the morphological characters of the female are variable and unreliable; therefore, he did not include a key to the females in his paper. It is important to consider the following when using the above key for females: (1) Definitive determination of the female should be based on presence of the male. (2) The key is useful if *only* females are collected. (3) The key does not include *Megarthroglossus sicamus* because a specimen was not available to us; however, it would occur in couplet 4 along with *M. cavernicolus* and *M. jamesoni*.

Previous authors have used the phrase (when referring to the posterior margin of sternum VII) "sinus lacking," or "sinus present but shallow." In many instances, the difference between lacking a sinus to having a shallow sinus is only an interpretation of the author. To clarify this point, we have used a comparison of depth to width. A width to depth ratio that exceeds 5 means that the margin has only a slight concavity and appears to lack a well-defined sinus.

Megarthroglossus becki Tipton & Allred

Figs. 35, 37, 40, 42, 68, 82, 100

Megarthroglossus becki Tipton and Allred 1951:108, 113; Mendez 1956:166; Stark 1959:100; Parker and Howell 1959:597-604; Hopkins and Rothschild 1962:380; Jellison and Glesne 1967:167; Tipton and Saunders 1971:18; Mendez and Haas 1972:285-288; Mendez and Haas 1973:1132; Lewis 1974:155.

TYPE HOST.— *Neotoma cinerea acraia* Nest.

TYPE LOCALITY.— Buckley's Mine, Rock Canyon, Provo, Utah Co., Utah.

TYPE SPECIMENS.— United States National Museum, Washington, D.C.

DIAGNOSIS.— MALE: The ventrolateral lobe of sternum VIII has a long, fingerlike caudally curved extension which distinguishes it from all other species (Fig. 40). The inner fovea of the immovable process (Fig. 42) of the clasper is located on the caudal margin and is more than 50 microns below dorsal margin of clasper. The hump on the dorsal margin of the aedeagus varies in height from 4.4 to 11.0 microns (average of 8.0). In most of the specimens measured, the hump was observed as only a slight swelling in the area

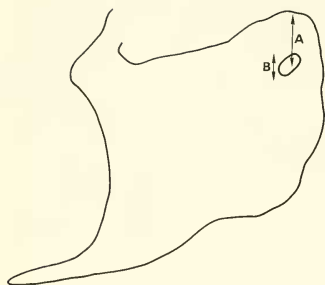


Fig. 32. Measurements which show the position of the inner fovea in relation to the dorsal margin of the immovable process of the clasper. A represents the distance of the fovea from the dorsal margin of the clasper. B represents the length of the inner fovea. The inner fovea in this illustration is submarginal.

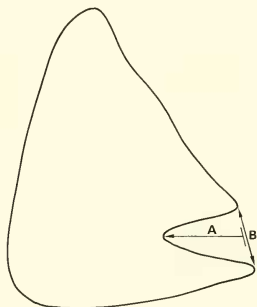


Fig. 33. Measurements of the sinus in the caudal margin of the female sternum VII. A represents the depth of the sinus and B represents the width of the sinus. The sinus ratio is equal to B divided by A.

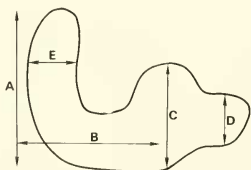


Fig. 34. Measurements of the spermatheca: A over B = hilla ratio; C over D = bulga ratio; E = width of hilla.

of the dorsal margin between the crescent sclerite and the sclerotized inner tube (S.I.T.).

FEMALE: The sinus in the posterior margin of sternum VII is more than 10 microns in depth or the depth to width ratio is less than 2.40 (see Fig. 2). Segment V of the labial palp is less than 270 microns in length (average). *Megarhroglossus becki* can be separated from *M. wilsoni*, its closest relative, in that the hilla is more than 35 microns in width, and it is less than 35 microns in *M. wilsoni*.

DISTRIBUTION.—UTAH: Kane, Piute, Utah, and Wayne counties.

MATERIAL EXAMINED.—UTAH: (Kane Co.) 5♂, 3♀, ex *Neotoma albigula*, 5-XII-1971, BYU; 1♂, ex *Neotoma cinerea*, 13-X-1971, BYU; 1♂, ex *Peromyscus crinitus*, 11-XII-1971, BYU (these three collections were made in the NAV-KAI project site); (Piute Co.) 1♀, ex *Thomomys bottae*, Kingston, 26-VI-1952, Killpack and Beck, BYU; (Utah Co.) 3♂, 7♀ paratypes, ex *Neotoma cinerea* nest, Buckley's Mine, Provo, 24-XI-1949, Allred, BYU; 4♀, same host, same location 21-X-1950, Allred, BYU; 4♂, 4♀, same host, Provo, 25-XI-1948, Tipton, BYU; 1♀, same host, Rock Canyon, Provo, 24-II-1951, Allred and Beck, BYU; 1♀, same host, same location, 30-III-1951, Allred and Beck, BYU; 2♂, 3♀, ex *Neotoma cinerea*, Aspen Grove, American Fork Canyon, American Fork, 13-X-1951, Barnum et al., BYU; 1♂, 19♀, same host, Thistle, 2-XI-1951, Barnum et al., BYU; 3♀, same host, Spanish Fork Canyon, Spanish Fork, 2-XI-1951, Barnum et al., BYU.

DISCUSSION.—This species is associated with *Neotoma cinerea* ssp. and more particularly with the nests of this host. *Neotoma cinerea* occurs in Utah, Idaho, Arizona, Nevada, and California; however, *M. becki* has been collected only in Utah. It is likely that it has a broader distribution than collection records indicate.

Megarhroglossus bisetis Jordan & Rothschild

Figs. 45, 57, 72, 85, 101

Megarhroglossus bisetis Jordan and Rothschild 1915:54; Jellison and Good 1942:83; Ewing and Fox 1943:112; Eads and Menzies 1949:33-39; Eads 1950:54; Traub and Hoff 1951:1-23; Williams and Hoff 1951:310-311; Jellison, Locker, and Bacon 1953:104; Morlan 1954:446-448; Morlan 1955:93-125; Mendez 1956:167-168; Hopkins and Rothschild 1962:390; Jellison

and Clesne 1967:168; Rail et al. 1969:92-94; Forcum et al. 1969:112; Miller et al. 1970:698, 700-701; Clark et al. 1971:1191; Mendez and Haas 1972:285-288; Mendez and Haas 1973:1132; Lewis 1974:155.

Megarthroglossus divisus bisetis: Hubbard 1947:302; Jellison and Senger 1976:79.

TYPE HOST.—*Nicotoma* sp.

TYPE LOCALITY.—Beulah, San Miguel Co., New Mexico.

TYPE SPECIMENS.—British Museum of Natural History, South Kensington, London, England.

DIAGNOSIS.—MALE: The posterior margin of sternum VIII is evenly convex and there are 2 or 3 (usually 2) antepygial bristles as in *M. weaveri*. *Megarthroglossus bisetis* may be separated from *M. weaveri* on the basis of the following characters: the inner fovea of the immovable process is less than 35 microns from the dorsal margin; segment V of

labial palp is less than 220 microns in length; the spur of the crochet is more than 10 microns in length; and the finger of the clasper is less than 120 microns in length.

FEMALE: *Megarthroglossus bisetis*, *M. weaveri*, and some specimens of *M. smiti* and *M. divisus* possess two antepygial bristles. *Megarthroglossus bisetis* may be separated from *M. smiti* and *M. divisus* in that the hilla of the spermatheca exceeds 30 microns in width and sternum VII has a sinus depth-to-width ratio of less than 2.00, whereas this ratio is greater than 2.00 in *M. smiti* and *M. divisus*. *Megarthroglossus bisetis* can be separated from *M. weaveri* in that the former has a bulga which is compressed (the portion of the bulga to which the spermathecal duct attaches appears to be withdrawn or pushed into the other portion of the bulga).

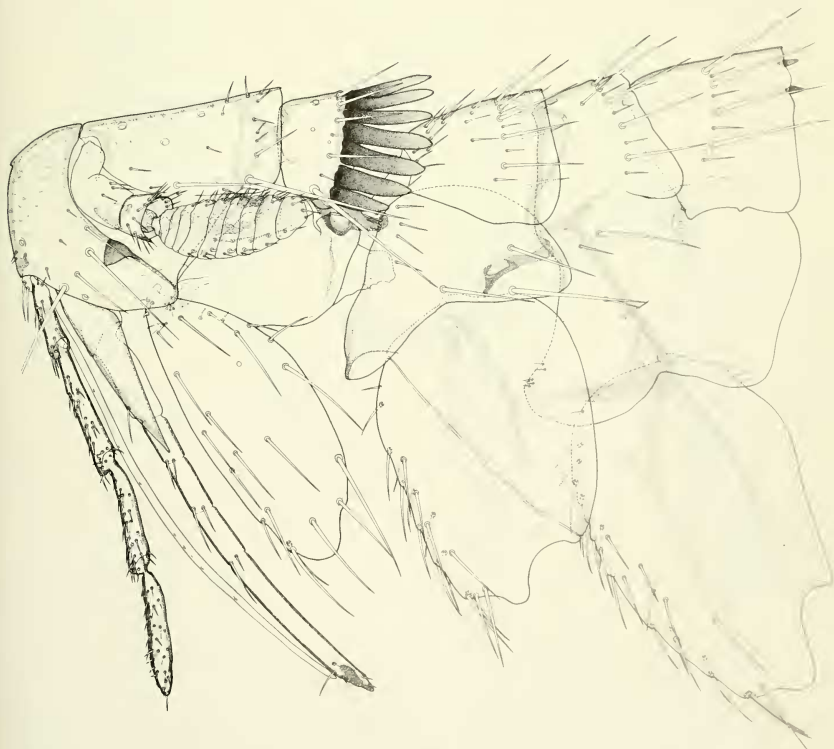
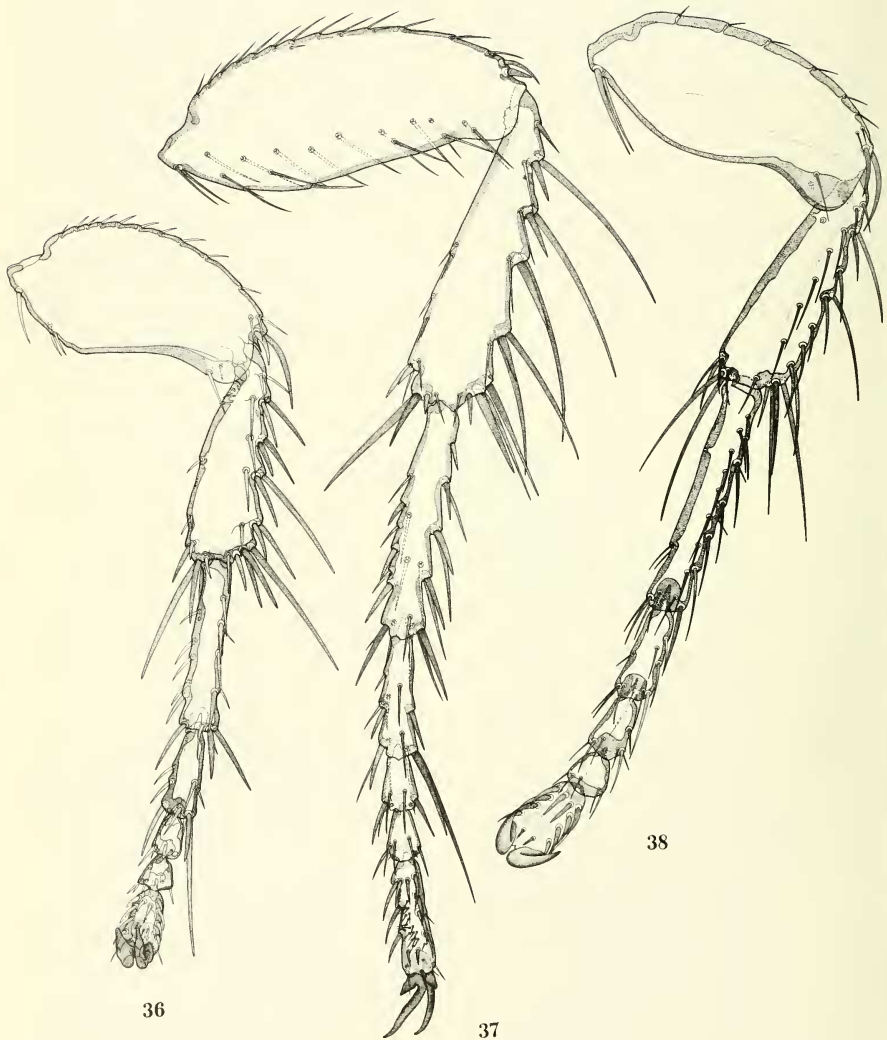


Fig. 35. *Megarthroglossus becki*: Male, head and thorax including coxae.



Figs. 36-38. Males, metathoracic legs; 36, *Callistopsyllus terinus deuterus*; 37, *Megarthroglossus becki*; 38, *Steinstomera alpina*.

DISTRIBUTION.—NEW MEXICO: Bernalillo, Chaves, Colfax, Guadalupe, Los Alamos, McKinley, Rio Arriba, Sandoval, San Miguel, Santa Fe, and Valencia counties. TEXAS: Donley County. The usual host is *Neotoma*, but a few records are from *Peromyscus*.

MATERIAL EXAMINED.—NEW MEXICO: (Chaves Co.) 5 ♂, 6 ♀, ex *Neotoma micropus*, Red Bluff Ranch, 25-V-1967, Miller (Lewis); (McKinley Co.) 1 ♀, ex *Neotoma mexicana*, Fort Wingate Army Depot, 12-X-1977, Marroquin (USAGHA).

Megarthroglossus cavernicolus Mendez & Haas

Figs. 39, 41, 70, 83, 100

Megarthroglossus cavernicolus Mendez and Haas 1972:285-288, 1973:1137.

TYPE HOST.—*Neotoma cinerea* nest.

TYPE LOCALITY.—Jemez Mts., Sandoval Co., New Mexico.

TYPE SPECIMENS.—United States National Museum, Washington, D.C.

DISTRIBUTION.—NEW MEXICO: Sandoval County.

DIAGNOSIS.—MALE: The dorsal margin of the aedeagus is straight or, if a hump is present, its height is less than 7 microns. The inner fovea of the immovable process is less than 20 microns below the dorsal margin of the clasper, and is submarginal in relation to the posterior border. The posterior margin of sternum VIII is sinuate, with a subtruncate ventrolateral lobe. The spur of the crochets is less than 20 microns in length. Sternum IX is less than 180 microns in length. *Megarthroglossus cavernicolus* resembles *M. divivisus* and *M. wilsoni*, but the characters given above will serve to separate these species.

FEMALE: The bulga is not compressed in *M. cavernicolus*, *M. weaveri*, *M. spenceri*, and *M. jamesoni*. *Megarthroglossus weaveri* and *M. spenceri* possess a sinus in the posterior margin of sternum VII, which is lacking in *M. cavernicolus* and *M. jamesoni*. *Megarthroglossus cavernicolus* can be separated from *M. jamesoni* in that segment V of the labial palp is less than 230 microns in length and the hilla is less than 40 microns in width. Also, *M. cavernicolus* could be confused with *M. sicamus*; however, the hilla of *M. sicamus*

is curved toward the bulga instead of bent away from the bulga as in *M. cavernicolus*.

DISTRIBUTION.—NEW MEXICO: Sandoval County.

MATERIAL EXAMINED.—NEW MEXICO: (Sandoval Co.) 11 ♂, 21 ♀ paratypes, ex *Neotoma cinerea* nest, cave west edge Valle Grande, Jemez Mts., 2636 m, 18-IX-1970, Haas et al. (Mendez); 1 paratype ♀, ex *Neotoma cinerea* nest, cave northwest side Telephone Canyon, Jemez Mts., 2600 m, 20-XI-1970, Haas et al. (Mendez).

DISCUSSION.—*Megarthroglossus cavernicolus* and *M. bisetis* have been collected from the same wood rat nest. Further study is necessary to understand more fully the ecological and taxonomic relationships of these two species. Mendez (1956) indicated that *M. cavernicolus* may be sympatric with *M. divivisus* as well. *Neotoma cinerea* appears to be the preferred host for this flea.

Megarthroglossus divivisus (Baker)

Figs. 47, 48, 59, 60, 73, 74, 86, 87, 100

Pulex divivisus Baker 1889:54

Ceratophyllus divivisus Baker 1904:388, 441; Baker 1905:134; C. Fox 1914:27; Dunn and Parker 1923:2772, 2775.

Ceratophyllus longispinus Wagner 1889:560.

Pulex longispinus: Baker 1895:131-132.

Megarthroglossus longispinus: Jordan and Rothschild 1915:52-53; Wagner 1930:130; Wagner 1936:186; Spencer 1936:14; Eskey and Haas 1939:1472; Mail and Holland 1939:126; Eskey and Haas 1940:29-74.

Megarthroglossus longispinus var. *exsecatus* Wagner 1936:196.

Megarthroglossus divivisus: Spencer 1936:14; Hubbard 1940:37(4); Auguston 1941:1952; Jellison, Kohls, and Mills 1943:1-22; Stanford 1944:175; Brown 1944:209; Pollitzer 1952:231-342; Allred 1968:73-87; Mendez and Haas 1972:285-288; Jellison and Senger 1976:79.

Megarthroglossus divivisus (*longispinus*) var. *exsecatus*: Holland 1949a:11.

Megarthroglossus divivisus exsecatus: Jellison and Good 1942:83; Ewing and Fox 1943:112-113; Hubbard 1943:1-12; Hubbard 1947:301; Holland 1949a:9; Holland 1949b:99-100; Jellison, Locker, and Bacon 1953:105; Mendez 1956:168-170; Hopkins and Rothschild 1962:389; Jellison and Senger 1973:46; Lewis 1974:155; Jellison and Senger 1976:79.

Megarthroglossus divivisus divivisus: Jellison and Good 1942:83; Ewing and Fox 1943:112; Hubbard 1947:300-301; Holland 1949a:9; Holland 1949b:99; Tipton 1950:64; Hopkins 1952:363-365; Allred 1952:67-75; Beck et al. 1953:43-52; Jellison, Locker, and Bacon 1953:104; Morlan 1954:446-448; Beck 1955:1-64; Morlan 1955:93-125; Wiseman 1955:1-28; Mendez 1956:168-170; Stark 1959:101; Hopkins and Rothschild 1962:



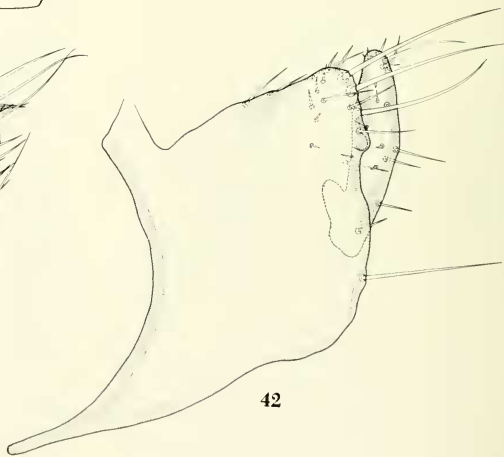
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41



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Figs. 39-42. Males, sterna VIII and IX; 39, *Megarthroglossus cavernicolus*; 40, *M. becki*; 41-42. claspers; 41, *M. cavernicolus*; 42, *M. becki*.

387; Jellison and Glesne 1967:168-170; Tipton and Saunders 1971:18; Jellison and Senger 1973:44-45; Pratt and Stark 1973:1-42; Lewis 1974:155.

TYPE HOST.—*Tamiasciurus hudsonicus fremonti*.

TYPE LOCALITY.—Georgetown, Clear Creek Co., Colorado.

TYPE SPECIMENS.—United States National Museum, Washington, D.C.

DIAGNOSIS.—**MALE:** The posterior margin of sternum VIII is sinuate, with an evenly convex ventrolateral lobe. The dorsal margin of the aedeagus is straight or if a hump is present it is less than 10 microns in height. The inner fovea of the immovable process is less than 20 microns in length. The spur of the crochet is less than 60 microns in length. Segment V of the labial palp exceeds 170 microns in length. *Megarhroglossus divisus* most closely resembles *M. cavernicolus* and *M. wilsoni*, but the characters given above are diagnostic.

FEMALE: The bulga is compressed. The sternum VII sinus ratio is less than 3.00. Segment V of the labial palp is more than 270 microns in length (average length). *Megarhroglossus divisus* most closely resembles *M. smiti*, but the two species may be separated in that the hilla ratio is less than 1.20 and the bulga ratio is less than 1.70 (see Fig. 34) in *M. divisus*.

DISTRIBUTION.—ARIZONA: Apache County. CALIFORNIA: San Bernardino and Mono counties. COLORADO: Clear Creek and Montezuma counties. IDAHO: National Reactor Testing Site including parts of Bingham, Butte, and Jefferson counties. MONTANA: Beaverhead, Flathead, Lake, Madison, Missoula, Park, Powell, and Ravalli counties. NEW MEXICO: Bernalillo, Colfax, Lincoln, McKinley, Otero, Rio Arriba, Sandoval and Santa Fe counties. NEBRASKA: Scotts Bluff County. OREGON: Wallowa County. TEXAS: Donley County. UTAH: Cache, Carbon, Duchesne, Iron, Kane, San Juan, Sevier, Tooele, Uintah, Utah, Wasatch, and Wayne counties. WYOMING: Albany and Waskokie counties. CANADA: Alberta, British Columbia.

MATERIAL EXAMINED.—CALIFORNIA: (San Bernardino Co.) 2 ♂, ex rodent nest, Big Bear Lake, 30-X-1958, Poll and Perry (Barnes). COLORADO: (Montezuma Co.) 1 ♂, 1 ♀, ex *Peromyscus truei*/*P. maniculatus*, Mesa

Verde National Park, 11-I-1962, Douglas (BYU); 3 ♀, same host, same location, 24-XI-1961, Douglas (BYU); 1 ♀, same host, same location, 25-X-1961, Douglas (BYU); 2 ♀, same host, same location, 13-X-1961, Douglas (BYU); 1 ♂, 1 ♀, same host, same location, 18-X-1961, Douglas (BYU); 1 ♀, same host, same location, 14-X-1961, Douglas (BYU); 1 ♂, same host, same location, 27-X-1961, Douglas (BYU); 1 ♂, 1 ♀, same host, same location, 24-XI-1961, Douglas (BYU). IDAHO: (National Reactor Testing Site), 1 ♂, ex *Peromyscus maniculatus*, Idaho Falls, 16-I-1967, BYU; 1 ♀, ex *Neotoma cinerea*, same location, 22-VIII-1967, BYU; 3 ♂, 5 ♀, ex *Neotoma cinerea* nest, same location, 17-II-1967. MONTANA: (Flathead Co.) 7 ♂, 4 ♀, ex *Neotoma* nest, no specific location, 4-III-1963, Senger; 6 ♂, 10 ♀, same host, same location, III-1963, Senger; (Lake Co.) 2 ♂, 3 ♀, ex *Neotoma* nest, Ravalli, 15-IV-1963, Senger; (Missoula Co.) 1 ♀, ex *Neotoma cinerea*, Rattlesnake Creek, 9-XI-1957, Senger; 6 ♂, 12 ♀, ex *Neotoma* nest, no specific location, III-1963, Senger; (Park Co.) 1 ♂, ex *Peromyscus maniculatus*, Frozen Lake, no date given, Pattie (Senger); (Ravalli Co.) 8 ♂, 7 ♀, ex *Neotoma* nest, no specific location, no date given, Senger; 7 ♂, 15 ♀, same host, 8 Mile Creek, 1962, Senger; 1 ♀, ex mouse nest, Airport, 3-I-1963, Senger; 13 ♂, 38 ♀, ex *Neotoma* nest, 8 Mile Creek, 29-XII-1962, Senger; 1 ♀, ex pine squirrel nest, no specific location, 17-II-1963, Senger. NEW MEXICO: (McKinley Co.) 1 ♂, ex *Peromyscus maniculatus*, no specific location, 12-V-1967, CDC; (Rio Arriba Co.) 1 ♂, ex *Peromyscus boylii*, Lindrith, 12-I-1951, CDC. NEBRASKA: (Scotts Bluff Co.) 1 ♂, ex *Peromyscus* nest, Morrill, 24-V-1949, CDC. UTAH: (Carbon Co.) 1 ♀, ex *Tamiasciurus hudsonicus*, Schofield, 12-VIII-1960, Pritchett (BYU); (Duchesne Co.) 1 ♀, same host, Duchesne, 7-VIII-1953, Killpack and Coffey (BYU); (Iron Co.) 1 ♀, ex *Tamiasciurus fremonti*, Cedar Breaks, Brianhead, 7-VIII-1949, Tipton (BYU); 1 ♀, ex *Tamiasciurus hudsonicus*, same location, 23-VI-1960, Pritchett (BYU); (Kane Co.) 2 ♂, 1 ♀, ex *Peromyscus truei*, 2-XII-1971, BYU; 1 ♂, same host, 13-XI-1971, BYU; (Sevier Co.) 3 ♂, ex *Tamiasciurus hudsonicus*, Koosharem, 22-VII-1953, Beck et al. (BYU); (Uintah Co.) 4 ♀, ex *Peromyscus maniculatus* nest, Jensen,

7-XI-1952, Beck and Beck (BYU); 1 ♀, ex *Peromyscus maniculatus*, 8-XI-1952, Beck and Beck (BYU); (Wayne Co.) 23 ♂, 17 ♀, ex *Tamiasciurus fremonti* nest, Elkhorn RS., 9-VIII-1952, Killpack et al. (BYU). WYOMING: (Albany Co.) 1 ♂, 1 ♀, ex *Neotoma*, no specific location. 9-VII-1943 (CDC); (Waskaki Co.) 2 ♂, 1 ♀, ex *Sylvilagus audubonii*, no specific location, 1-XI-1979, Carter (CDC).

HOST SYNONYMY.—*Tamiasciurus fremonti* = *Tamiasciurus hudsonicus fremonti*.

DISCUSSION.—*Megarthroglossus divisus* has been collected in all western states except Washington and Nevada. It probably occurs in these states as well, because the hosts on which it occurs most frequently (i.e. *Tamiasciurus*, *Peromyscus*, and *Neotoma*) occur there. It has also been collected from Alberta and British Columbia, Canada. Mendez (1956) and Hopkins and Rothschild (1962) treated this taxon as two subspecies: *M. divisus divisus* and *M. divisus exsecutus*. Upon close examination, there appeared to be three populations: *M. d. divisus* associated with *Tamiasciurus*; *M. d. exsecutus* associated with *Neotoma*; and a third population associated with *Peromyscus*. Measurements of various morphological characters showed the third population to be intermediate between the other two. However, the three populations are extremely difficult to separate since they have overlapping distributions. It appears that the three populations represent a single species and there are no characters which can be used consistently for subspecies discrimination. More than 300 specimens have been examined, and more than 100 specimens have been measured.

Megarthroglossus jamesoni Smit

Figs. 54, 66, 67, 84, 100

Megarthroglossus jamesoni Smit 1953:202-203; Mendez 1956:170; Hopkins and Rothschild 1962:376; Lewis 1974:155.

TYPE HOST.—*Neotoma cinerea* nest.

TYPE LOCALITY.—Pine Nut Mts., Douglas Co., Nevada.

TYPE SPECIMENS.—British Museum (Natural History), South Kensington, London, England.

DIAGNOSIS.—MALE: The median dorsal lobe of the aedeagus is reduced to a short blunt lobe in *M. jamesoni* and *M. sierrae* and this character may be used to separate these species from *M. smiti*. *Megarthroglossus sierrae* and *M. jamesoni* may be distinguished from each other in that the latter has a hump on the dorsal margin of the aedeagus that exceeds 30 microns; segment V of the labial palp is more than 220 microns in length; the inner fovea of the immovable process is more than 30 microns below the dorsal margin of the clasper and it is submarginal; and the ventrolateral lobe of sternum VIII is truncate.

FEMALE: The bulga is not compressed; the width of the hilla exceeds 40 microns which is broader than either *M. sicamus* or *M. cavernicolus*. The spermathecae of *M. jamesoni* and *M. cavernicolus* are similar in that both lack the posteriorly directed hilla observed in *M. sicamus*. Segment V of the labial palp exceeds 270 microns in length, but it is less than 230 microns in *M. cavernicolus*.

DISTRIBUTION.—CALIFORNIA: Lassen County. NEVADA: Douglas County.

MATERIAL EXAMINED.—CALIFORNIA: (Lassen Co.) 1 ♂, 1 ♀, ex *Neotoma cinerea*, Fort Sage Mts., 26-II-1975, Smith and Nelson; 1 ♂, 1 ♀, ex *Neotoma lepida*, same location, same date, Smith and Nelson. NEVADA: (Douglas Co.) 2 ♂, 3 ♀, ex *Neotoma cinerea* nest, Pine Nut Mts., 25-III-1951, Jameson.

DISCUSSION.—*Megarthroglossus jamesoni* has been collected only from species of *Neotoma* and their nests. Further collections will be necessary to make any meaningful statement regarding host associations of this flea. Mendez (1956) examined 2 males and 1 female from Malheur Co., Oregon, but declined to refer them to *M. jamesoni* because of the limited amount of study material. He observed slight differences in the male genitalia of this flea, but did not include drawings or host data. Subsequently, specimens of *M. jamesoni* were collected in northern California. It would have been helpful to compare the Oregon specimens with those from California and Nevada.

Megarthroglossus procus muii Augustson

Figs. 49, 61, 78, 90, 101

Megarthroglossus muiri Augustson 1953:122-125; Mendez 1956:163, 171; Jellison and Glesne 1967:172.

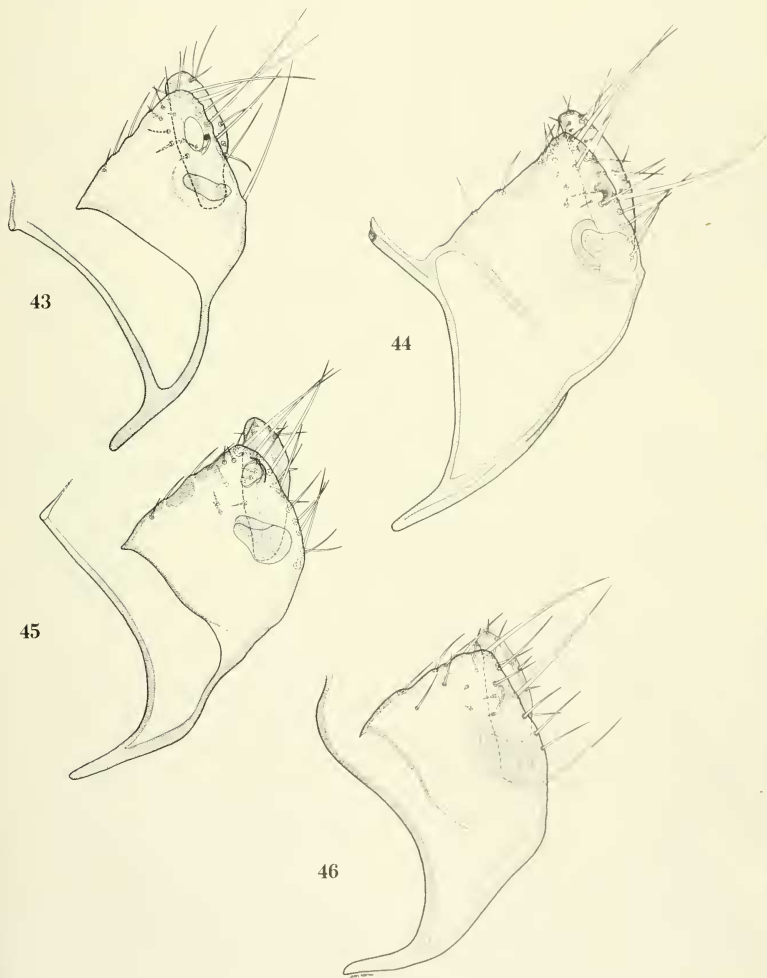
Megarthroglossus procus muiri: Hopkins and Rothschild 1962:374.

TYPE HOST.—*Tamiasciurus douglasi albolineatus* and *Sorex palustris navigator*.

TYPE LOCALITY.—Tully's Hole, Fresno Co., California.

TYPE SPECIMENS.—Allan Hancock Foundation, University of Southern California, Los Angeles, California.

DIAGNOSIS.—MALE: The two subspecies of *Megarthroglossus procus* may be separated from all other species of *Megarthroglossus* by the following characters: The ventrolateral

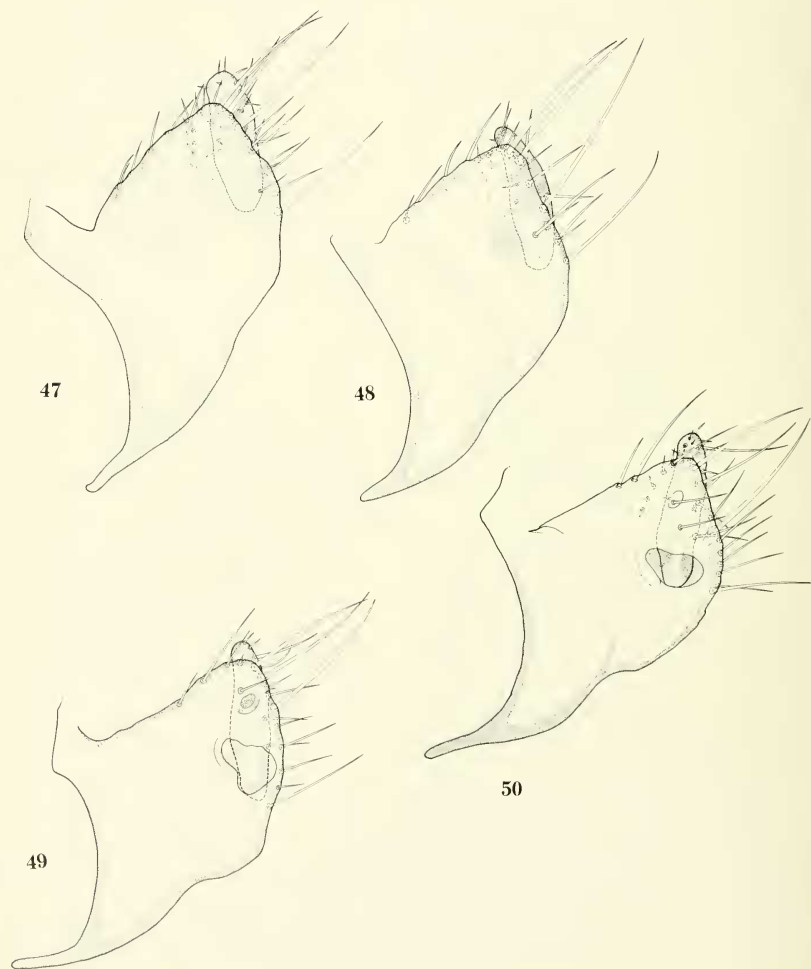


Figs. 43-46. Males, claspers; 43, *Megarthroglossus wilsoni*; 44, *M. sicamus*; 45, *M. bisetis*; 46, *M. weaveri*.

lobe of sternum VIII is divided into an upper evenly convex lobe and a lower acuminate lobe separated by a sharp sinus; the crochet does not possess the well-defined spur observed in other species such as *M. divisus*; however, a short lobe less than 10 microns may be present in some. *Megarthroglossus p.*

muiri can be distinguished from *M. p. procus* in that the latter has a median dorsal lobe which is less than 20 microns in width; segment V of the labial palp is 130 microns in length and the sinus in sternum VIII exceeds 45 microns in depth.

FEMALE: Usually there is no sinus in the



Figs. 47-50. Males, claspers: 47, *Megarthroglossus divisus* (Wayne Co., Utah); 48, *M. divisus* (Ravalli Co., Montana); 49, *M. procus muiri*; 50, *M. p. procus*.

posterior margin of sternum VII, but, if present, it is less than 10 microns in depth; there are 3 antepygial bristles per side; the pronotal comb has 6 spines per side; the hilla ratio exceeds 1.50, and the bulga ratio exceeds 1.50 (Fig. 34). These characters are adequate for separation of *M. p. procus* and *M. p. muiri*, but the presence of males in a collection aids greatly in subspecific discrimination.

DISTRIBUTION.— CALIFORNIA: Fresno, Mono, and Plumas counties.

MATERIAL EXAMINED.— CALIFORNIA: (Fresno Co.) 1 ♂, holotype, ex *Tamiasciurus douglasi albolimbatus*, Tully's Hole, 25-VIII-1941, Auguston; 1 ♀, allotype, ex *Sorex sp. navigator*, Tully's Hole, 24-VIII-1941, Auguston; (Plumas Co.) 1 ♂, ex *Peromyscus maniculatus* 6.4 km E of Quincy, 1520 m, 24-X-1949, Jameson.

HOST SYNONYMY.— *Tamiasciurus douglasi albolimbatus* = *Tamiasciurus hudsonicus albolimbatus*.

DISCUSSION.— *Megarathroglossus procus muiri* has been collected from species of *Tamiasciurus*, *Ochotona*, and *Sorex*. Additional specimens are necessary to determine host associations of this flea. It has been collected only in California; however, it is likely that it occurs in Nevada, Oregon, and Washington as well.

Megarathroglossus procus procus Jordan & Rothschild

Figs. 50, 62, 76, 77, 88, 89, 101

Megarathroglossus procus procus Jordan and Rothschild 1915:47-50; Wagner 1930:130; Spencer 1936:14; Mail and Holland 1940:126; Hubbard 1940:37(4); Auguston 1941:151; Ewing and Fox 1943:113; Hubbard 1943:1-12; Hatt 1943:311-345; Hubbard 1947:297; Hubbard 1949:126; Holland 1949a:10; Holland 1949b:100; Tipton 1950:63; Hopkins 1952:363-365; Mendez 1956:164-166; Jameson and Brennan 1957:45-54; Stark 1959:100; Beck 1966:76; Beck and Allred 1966:13; Jellison and Glesne 1967:172; Tipton and Saunders 1971:18; Mendez and Haas 1972:285-288; Mendez and Haas 1973:1132; Lewis 1974:155; Egoscue 1976:478; Jellison and Senger 1976:80.

Megarathroglossus similis Wagner 1936:196; Mail and Holland 1939:126; Jellison and Good 1942:84; Ewing and Fox 1943:113; Hubbard 1943:1-12; Hubbard 1947:302; Holland 1949a:10; Holland 1949b:99; Jellison, Locker, and Bacon 1953:107; Mendez 1956:175.

Megarathroglossus scnisles (sic) Spencer 1936:14.

Megarathroglossus procus oregonensis Hubbard 1947:299-300; Jellison, Locker, and Bacon 1953:105.

Megarathroglossus procus procus Hubbard 1947:297; Jellison, Locker, and Bacon 1953:105; Hopkins and Rothschild 1962:371-372.

TYPE HOST.— *Spilogale* sp.

TYPE LOCALITY.— Chilliwack, British Columbia, Canada.

TYPE SPECIMENS.—British Museum (Natural History), London.

DIAGNOSIS.— MALE: The two subspecies of *M. procus* have a divided ventrolateral lobe of sternum VIII which is not present in other species of the genus *Megarathroglossus*. *M. p. procus* may be separated from *M. p. muiri* in that in the former the median dorsal lobe of the aedeagus is more than 20 microns in width; segment V of the labial palp is more than 140 microns in length; and the sinus in sternum VIII is less than 45 microns in depth.

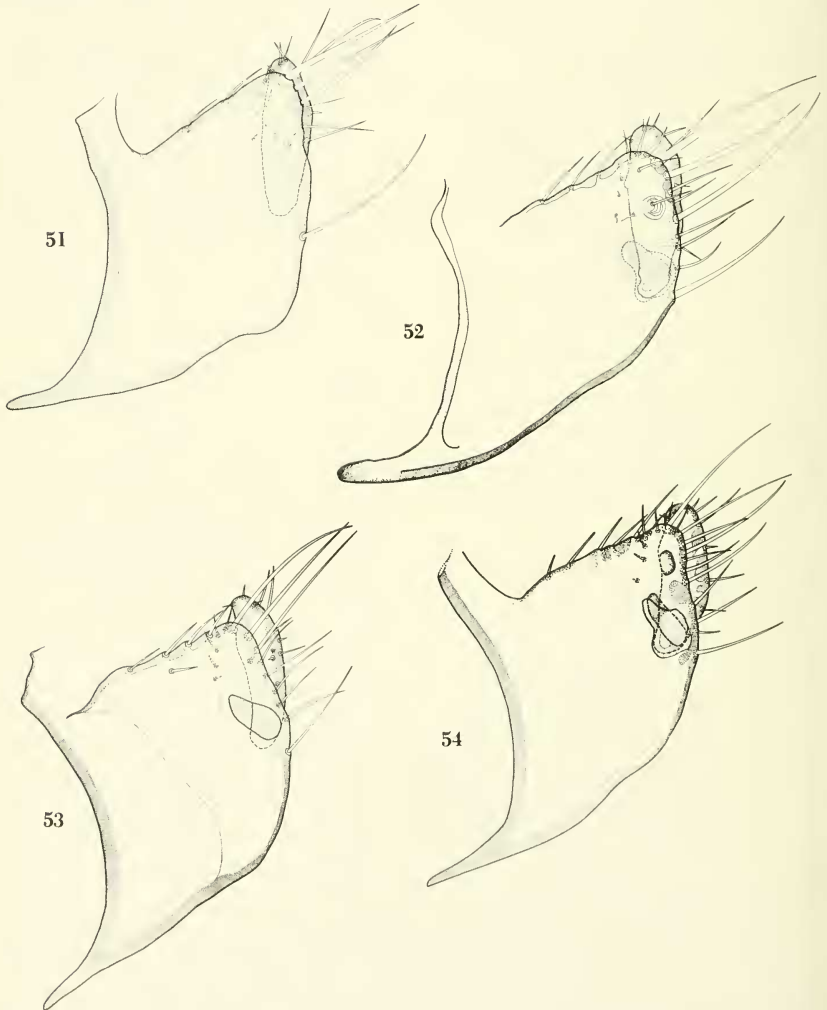
FEMALE: The pronotal comb has 6-8 spines per side; there are 2 or 3 antepygial bristles; there is no sinus in the caudal margin of sternum VII or, if it is present, it is less than 10 microns in depth; the hilla ratio is less than 1.20 and the bulga ratio is less than 1.40. However, a definite identification is possible only if male specimens are available.

DISTRIBUTION.— CALIFORNIA: Eldorado, Plumas, and San Bernardino counties. COLORADO: Montezuma County. NEBRASKA: SIOUX COUNTY. NEVADA: Douglas and Washoe counties. OREGON: Hood River, Linn, and Washington counties. WASHINGTON: Skagit, Whatcom, and Yakima counties. WYOMING: Laramie and Weston counties. UTAH: Utah County. CANADA: British Columbia.

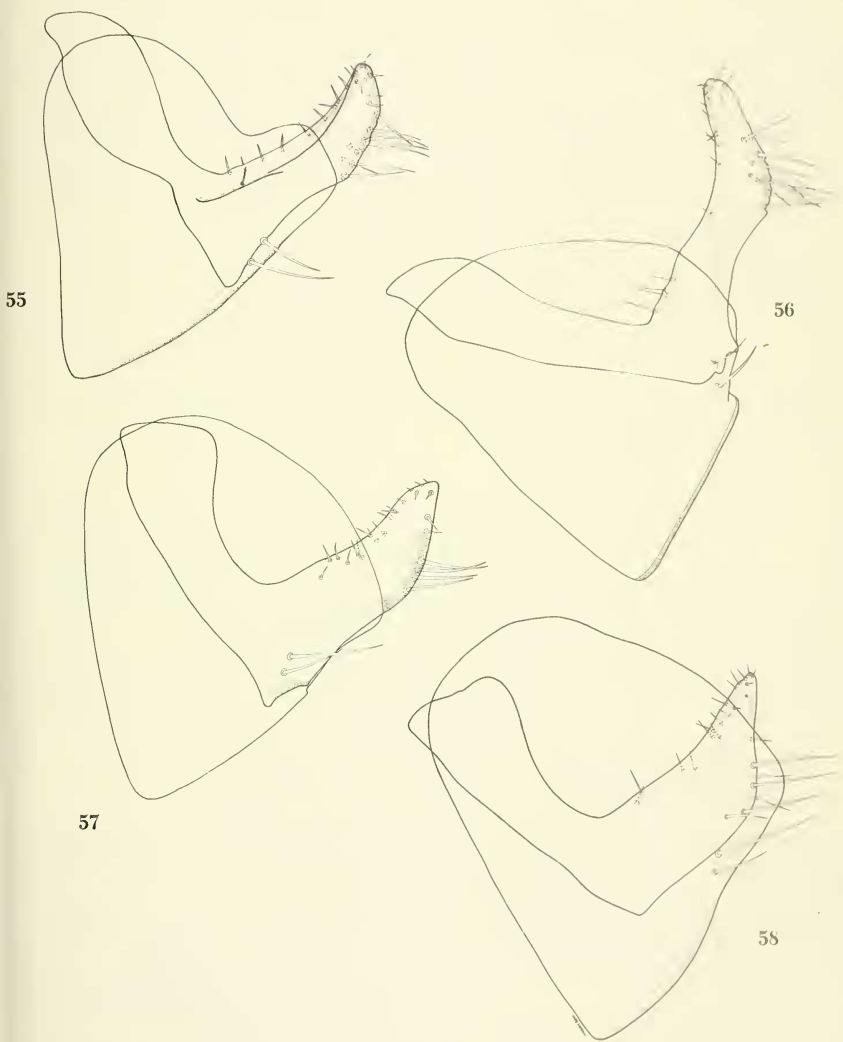
MATERIAL EXAMINED.— CALIFORNIA: (El Dorado Co.) 2 males, 1 female, ex chipmunk, no specific location, X-1936, Eskey (Jellison); (San Bernardino Co.) 1 male, ex *Citellus lateralis*, Big Bear Lake, 13-V-1955, Martin. NEVADA: (Washoe Co.) 1 ♂, 1 ♀, ex chipmunk, no specific location, X-1936, Eskey (Jellison). OREGON: (Linn Co.) 1 ♀, ex *Tamiasciurus douglasi*, 2.4 km N of Big Lake, 1-XI-1969, Maser; 1 ♂, ex *Eutamias townsendi*, T14S, R6E, NE ¼, Sec. 28, 1400 m, 12-IX-1972, Maser; 1 ♀, ex *Peromyscus maniculatus*, same location, same elevation, same date, Maser; 1 ♀, ex *Glaucomyx sabrinus*, T15S, R15E, SE¼, Sec. 11, 26-IX-1972, Maser; 1 ♀, same host, T25S, R6E, SE¼, Sec. 11, 1040 m, same date, Maser; 1 ♀, same host, T15S, R5E, SG¼, Sec. 11, same eleva-

tion, 28-IX-1972, Maser; (Washington Co.) 1 ♂, 1 ♀, paratypes, ex *Tamiasciurus d. douglasi*, Caston, 7-III-1932, Hubbard (BYU); 1 ♂, 1 ♀, paratypes same host, same location, 8-III-1932, Hubbard (BYU). WASHINGTON: (Skagit Co.) 2 ♂, 7 ♀, ex *Neotoma* nest, Blanchard Caves, 19-III-1966, Senger; 3 ♀, same host, same location, XII-1965, Senger;

10 ♂, 12 ♀, same host, same location, 20-XI-1966, Senger; 15 ♂, 20 ♀, same host, same location, 5-XI-1967, Senger; 1 ♀, same host, same location, 18-IX-1967, Senger; 3 ♂, 5 ♀, same host, same location, 17-XI-1968, Senger; 3 ♂, 2 ♀, same host, same location, 9-III-1968, Senger; 6 ♂, 17 ♀, same host, same location, XI-1965, Senger; 15 ♂, 5 ♀,



Figs. 51-54. Males, claspers; 51, *Megarhroglossus smiti*; 52, *M. spenceri*; 53, *M. sicrae*; 54, *M. jamesoni*.



Figs. 55-58. Males, sterna VIII and IX: 55, *Megarthroglossus wilsoni*; 56, *M. sicamus*; 57, *M. bisetis*. 58, *M. weaveri*.

same host, same location, 20-XI-1965, Senger; 1 ♀, same host, same location, III-1965, Senger; 24 ♂, 21 ♀, same host, Lizzard Caves, 19-II-1966, Senger; 2 ♂, 6 ♀, same host, same location, 15-I-1966, Senger; 2 ♂, 1 ♀, same host, same location, XI-1965, Senger; (Wheaton Co.) 5 ♂, 5 ♀, same host, Glacier, X-1963, Senger; 1 ♀, ex nest in old fin snag, Chuckanut Mt., 14-II-1965, Senger; 1 ♀, ex nest in fallen snag, Silver-Fir Campground, Nooksack River, 3-IX-1966, Senger; (Yakima Co.) 2 ♀, ex *Ochotona princeps*, Chinook Pass, 16-IX-1966, Senger; CANADA: (British Columbia) 1 ♂, 1 ♀, ex *Tamiasciurus douglasi*, 11.2 km S of Boston Bar, 14-III-1948, Holland; 1 ♂, ex *Glaucomys* sp., Grouse Mt., Vancouver, 21-I-1947, Dowding (Holland); 1 ♂, ex *Sciurus douglasi*, Gambien Island, 21-II-1943, Holland; 1 ♀, ex squirrel, Cultus Lake, 31-X-1947, Leavens (Holland); 1 ♀, ex *Tamiasciurus* sp., Huntingdon, 16-XI-1946, Racey (Holland); 1 ♀, ex *Rattus norvegicus*, Vancouver, 7-I-1945, Holland.

HOST SYNONYMY.—*Tamiasciurus d. douglasi* = *Tamiasciurus hudsonicus douglasi*; *Sciurus douglasi* = *Tamiasciurus hudsonicus douglasi*; *Citellus lateralis* = *Spermophilus lateralis*.

DISCUSSION.—Most of the specimens in Dr. C. M. Senger's collection were taken from species of *Neotoma* in Washington. However, it has been collected from several other hosts, principally, *Tamiasciurus hudsonicus douglasi*.

Megarhroglossus sicamus

Jordan & Rothschild
Figs. 44, 56, 81, 91, 101

Megarhroglossus sicamus Jordan and Rothschild 1915:50-52; Dalla Torre 1924:17; Wagner 1936:196; Mail and Holland 1939:126; Jellison and Good 1942:84; Ewing and Fox 1943:113; Hubbard 1943:1-12; Costa Lima and Hathaway 1946:125; Hubbard 1947:302; Holland 1949a:10; Holland 1949b:101; Jellison, Locker and Bacon 1953:104; Mendez 1956:173-174; Hopkins and Rothschild 1962:382; Lewis 1974:155.

TYPE HOST.—*Canis latrans*.

TYPE LOCALITY.—Eagle River, Sicamous, British Columbia, Canada.

TYPE SPECIMENS.—British Museum (Natural History), South Kensington, London, England.

DIAGNOSIS.—MALE: The caudal margin of sternum VIII is evenly convex in *M. sicamus*, *M. bisetis* and *M. weaveri*. However, *M. sicamus* has a hump on the dorsal margin of the aedeagus that is more than 30 microns while it is less than 10 microns in the other two species. Other species which have a hump on the dorsal margin of the aedeagus include *M. spenceri*, *M. smitti*, *M. sierrae*, *M. jamesoni*, and *M. becki*. The inner fovea of the immovable process of the clasper is more than 60 microns below the dorsal margin in *M. sicamus* but not in the other five species mentioned.

FEMALE: No specimens were available for study. On the basis of the literature, it appears that *M. sicamus* most closely resembles *M. cavernicolus* and *M. jamesoni*. The hilla appears to be less than 40 microns in width but more than 40 microns in *M. jamesoni*. In *M. sicamus* the hilla is bent toward the bulga but in *M. cavernicolus* it is not.

DISTRIBUTION.—CANADA: British Columbia.

MATERIAL EXAMINED.—CANADA: (British Columbia) 1 ♀, ex *Lynx* sp., Kamloops, 20-V-1946, Carter (Holland); 1 ♀, ex *Neotoma*, Pavilion Lake, Pavilion, 5-VII-1950, Holland; 1 ♂, ex *Canis latrans*, Eagle River, Sicamous, 6-IX-1903, Dippie (Smit).

DISCUSSION.—*Megarhroglossus sicamus* has been collected only from British Columbia. Because of the paucity of specimens, reliable host association data are lacking.

Megarhroglossus sierrae Auguston

Figs. 53, 65, 69, 92, 100

Megarhroglossus ditisus sierrae Auguston 1953: 125-126; Jellison and Glesne 1967:170; Jellison and Senger 1976:79.

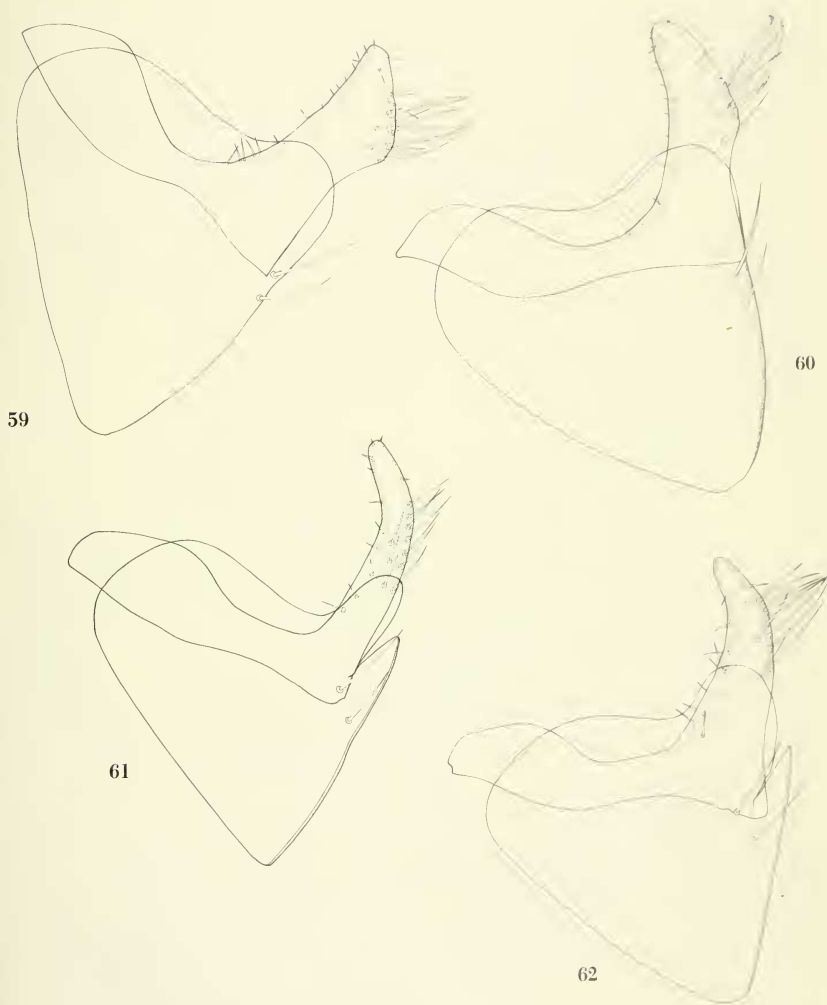
Megarhroglossus sierrae Mendez 1956:174; Hopkins and Rothschild 1962:378; Lewis 1974:155; Jellison and Senger 1976:80.

TYPE HOST.—*Ochotona schisticeps mui* and *Tamiasciurus douglasi albolimbatus*.

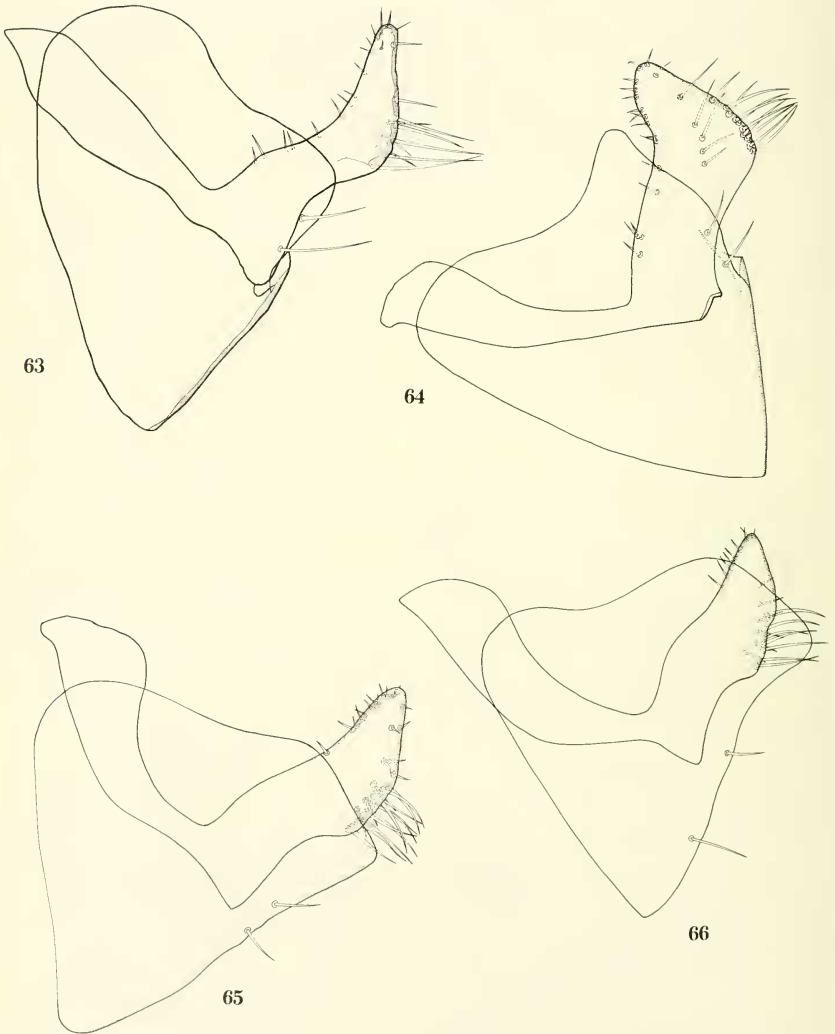
TYPE LOCALITY.—Cascade Valley, Fresno Co., California.

TYPE SPECIMENS.—Allan Hancock Foundation, University of Southern California, Los Angeles, California.

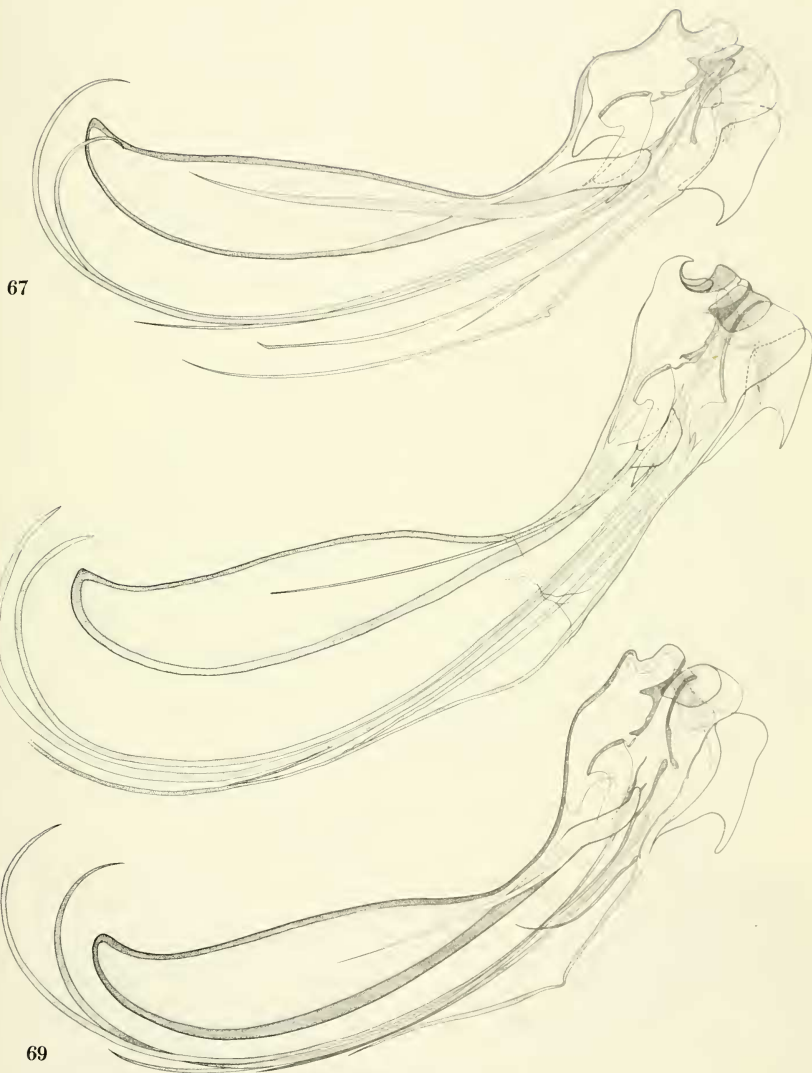
DIAGNOSIS.—MALE: *M. sierrae* and *M. jamesoni* resemble each other in that the me-



Figs. 59-62. Males, sterna VIII and IX; 59 *Megarthroglossus dicusis* (Wayne Co., Utah); 60, *M. dicusis* (Havalli Co., Montana); 61, *M. procus muiri*; 62, *M. p. procus*.



Figs. 63-66. Males, sterna VIII and IX; 63, *Megarthroglossus spenceri*; 64, *M. smiti*; 65, *M. sierrae*; 66, *M. jamesoni*.



Figs. 67-69. Males, aedeagus; 67, *Megarhroglossus jamesoni*; 68, *M. becki*; 69, *M. sierrae*.

dian dorsal lobe of the aedeagus is reduced to a short blunt lobe in both species. *M. sierrae* may be distinguished from *M. jamesoni* on the basis of the following characters: The hump on the dorsal margin of the aedeagus is less than 20 microns; segment V of the labial palp is less than 220 microns in length; the inner fovea of the immovable process is marginal, and the ventrolateral lobe of sternum VIII is subtruncate.

FEMALE: *M. sierrae* and *M. procius* ssp. each lack a sinus in the caudal margin of sternum VII, but, if a sinus is present, it is less than 10 microns in depth. In *M. sierrae* the vertical portion of the hilla is more than 115 microns and the hilla is more than 50 microns in width; metatarsal segment I is more than 300 microns in length.

DISTRIBUTION.—CALIFORNIA: Fresno and Mono counties.

MATERIAL EXAMINED.—CALIFORNIA: (Fresno Co.) 1 ♂, holotype, ex *Ochotona schisticeps muiri*, Cascade Valley, 27-VIII-1941, Augustson; (Mono Co.) 1 ♀, allotype, ex *Tamiasciurus douglasi albolimbatus*, Mammoth Lakes, 31-VII-1939, Augustson.

HOST SYNONYMY.—*Tamiasciurus douglasi albolimbatus* = *Tamiasciurus hudsonicus albolimbatus*.

DISCUSSION.—*Megarathroglossus sierrae* has been reported only from the type locality in California on *Tamiasciurus* and *Ochotona*. *Megarathroglossus sierrae*, *M. divisus*, and *M. procius* overlap in California in both ecological and geographical distribution. Additional data is needed to clarify the relationships of these species.

Megarathroglossus smiti Mendez

Figs. 51, 64, 79, 93, 101

Megarathroglossus smiti Mendez 1956:175; Howell 1955:35-48; Howell 1957:566-573; Parker and Howell 1959:597-604; Stark 1959:99; Hopkins and Rothschild 1962:385; Jellison and Glesne 1967:173; Tipton and Saunders 1971:18; Mendez and Haas 1973:1132; Jenkins and Grundmann 1973:81; Lewis 1974:155; Egoscue 1976:479; Jellison and Senger 1976:80.

TYPE HOST.—*Neotoma lepida* nest.

TYPE LOCALITY.—Lynnndyl, Millard Co., Utah.

TYPE SPECIMENS.—United States National Museum, Washington, D.C.

DIAGNOSIS.—MALE: *M. smiti*, like *M.*

sierrae and *M. jamesoni*, has a hump on the dorsal margin of the aedeagus; however, it is more pronounced in *M. smiti* than in *M. sierrae* and less so than in *M. jamesoni*. There is a considerable amount of variability in this character and so its taxonomic value is questionable. In *M. smiti* the median dorsal lobe is produced into a long process which curves caudally at the apex, and sternum VIII has an undulating posterior margin with a short, subacuminate lobe.

FEMALE: *M. smiti*, *M. divisus*, *M. becki*, and *M. wilsoni* are similar in many respects. *M. smiti* may be distinguished from the latter two species in that the depth to width ratio of the sinus in sternum VII is more than 3.0; segment V of the labial palp is more than 270 microns in length (average). *Megarathroglossus smiti* may be separated from *M. divisus* in that the sternum VII sinus ratio is more than 4.0; the hilla ratio exceeds 1.20 and the bulga ratio exceeds 1.80.

DISTRIBUTION.—NEVADA: Nye County. UTAH: Beaver, Emery, Juab, Millard, Tooele, and Utah counties.

MATERIAL EXAMINED.—NEVADA: (Nye Co.) 1 ♂, ex *Neotoma lepida*, Mercury, 6-XI-1961, AEC-NRTS (BYU). UTAH: (Juab Co.) 5 ♂, 2 ♀, ex *Neotoma lepida* nest, Jericho, 29-IV-1954, J. F. Howell; 1 ♂, 1 ♀, ex *N. lepida* 4.5 km N Jericho, 8-V-1954, J. F. Howell; 9 ♂, 16 ♀, ex *N. lepida* nest, Jericho, 8-X-1954, J. F. Howell, 5 ♂, 19 ♀, ex same host, same location, 29-X-1954, J. F. Howell; 3 ♂, 2 ♀, ex *N. lepida*, same location, same date, J. F. Howell; 2 ♂, 2 ♀, ex *N. lepida* nest, same location, 12-XI-1954, J. F. Howell; 15 ♂, 30 ♀, ex same host, same location, 2-XII-1954, J. F. Howell; 4 ♂, 4 ♀, ex same host, same location, 7-I-1955, J. F. Howell; (Millard Co.) 4 ♂, 5 ♀ paratypes, ex *N. lepida*, Lynnndyl, 17-XI-1951, Barnum and Moore; (Utah Co.) 1 ♂ paratype, ex *N. lepida*, Chimney Rock Pass, 15-X-1949, D. M. Alired; 7 ♂, 6 ♀ paratypes, ex same host, Rush Valley, 9-XI-1951, Barnum and Moore; 3 ♂, ex *Neotoma* nest, Chimney Rock Pass, 25-X-1968, Clark and Mathis.

DISCUSSION.—*Megarathroglossus smiti* has been collected in Utah and Nevada. The known geographical distribution of the host, *Neotoma lepida*, is greater than the known geographical distribution of *M. smiti*. More

extensive collecting of the host in Arizona, California, Idaho, and Oregon will likely expand the known distribution of *M. smiti*.

Megarthroglossus spenceri Wagner

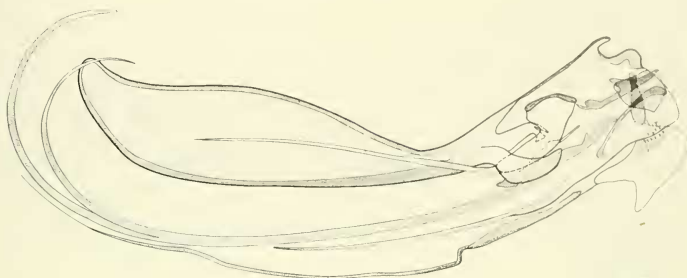
(Figs. 52, 63, 80, 94, 101)

Megarthroglossus spenceri Wagner 1936:196; Spencer 1935:14; Mail and Holland 1939:126; Jellison and Good

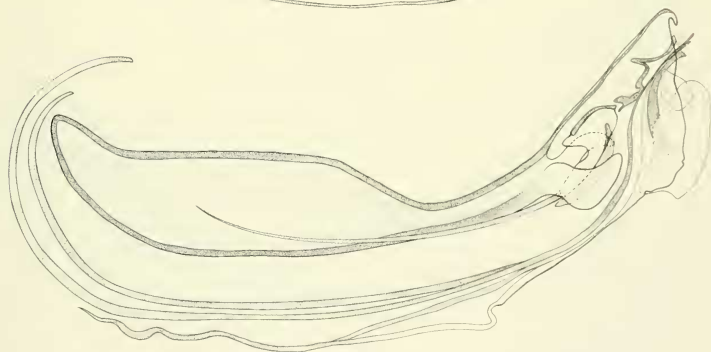
1942:84; Ewing and Fox 1943:114; Hubbard 1943:1-12; Costa Lima and Hathaway 1946:126; Hubbard 1947:303-304; Holland 1949a:10; Holland 1949b:101; Jellison, Locker, and Bacon 1953:107; Mendez 1956:177; Hopkins and Rothschild 1962:383-384; Lewis 1974:155.

Megarthroglossus pygmaeus Wagner 1936:196; Jellison and Good 1942:84; Ewing and Fox 1943:113; Hubbard 1943:1-12; Costa Lima and Hathaway 1946:126; Hubbard 1947:303; Holland 1949a:10; Holland 1949b:

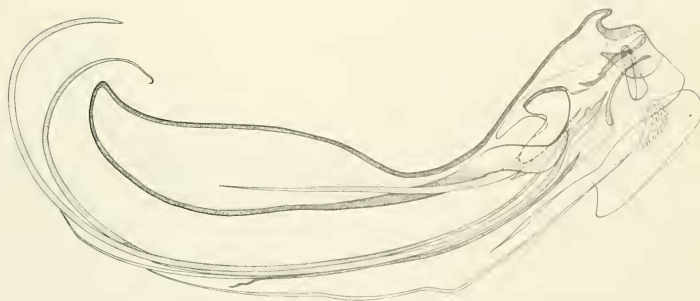
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72



Figs. 70-72. Males, aedeagus; 70, *Megarthroglossus cavernicolus*; 71, *M. weaveri*; 72, *M. bisetis*.

100-101; Jellison, Locker, and Bacon 1953:106; Mendez 1956:172-173; Hopkins and Rothschild 1962:384.

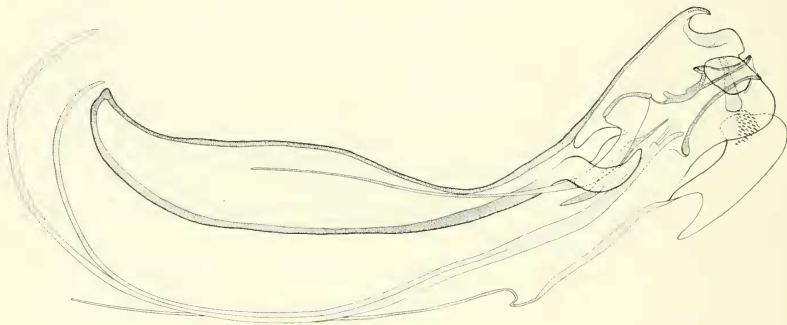
TYPE HOST.—*Neotoma cinerea* and *Ochotona princeps*.

TYPE LOCALITY.—Nicola, British Columbia, Canada.

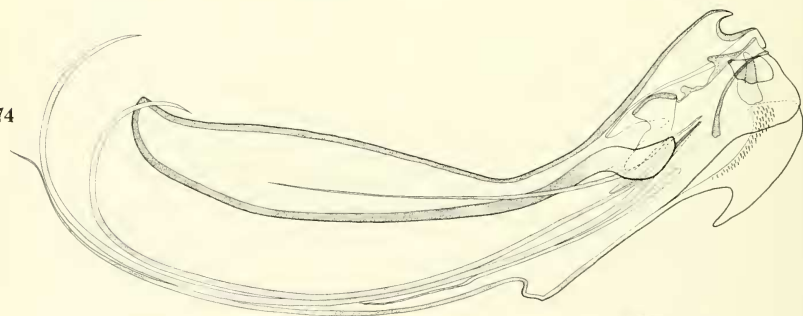
TYPE SPECIMENS.—Canadian National Collection, Ottawa, Ontario.

DIAGNOSIS.—MALE: *M. spenceri* bears a resemblance to *M. smiti*, *M. sierrae*, and *M. jamesoni*. Only *M. spenceri* has an angular denticle (toothlike process) on the anterior margin of the movable process of the clasper. In addition, one inner fovea of the immovable process of the clasper is more than 50 microns below the dorsal margin of the clas-

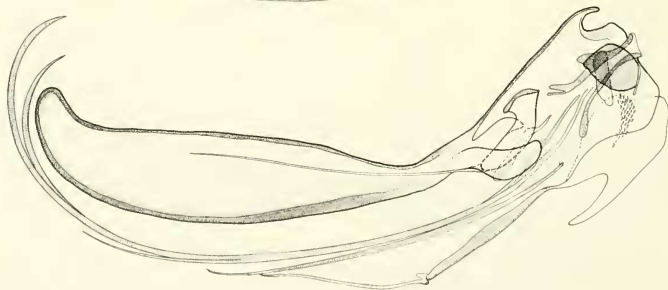
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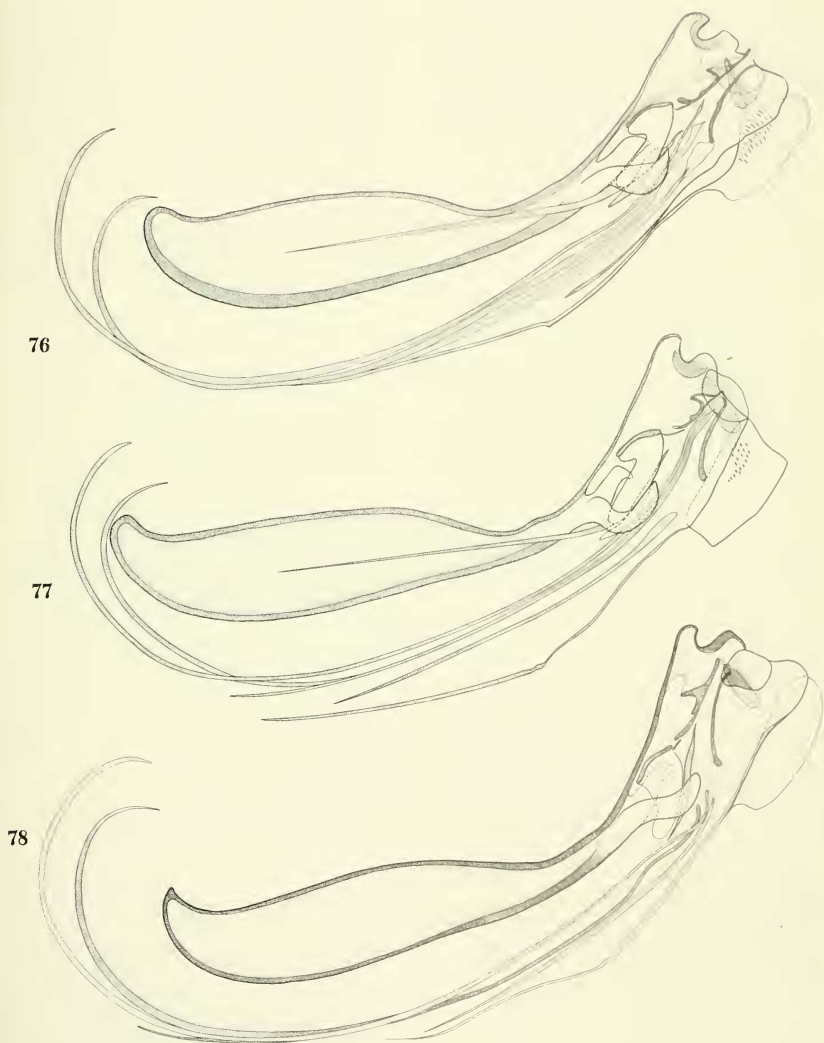
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75



Figs. 73-75. Males, aedeagus; 73, *Megarthroglossus divicus* (Bavalli Co., Montana); 74, *M. divicus* (Wayne Co., Utah); 75, *M. wilsoni*.



Figs. 76-78. Males, aedeagus; 76, *Megarthroglossus procus procus* (Whatcom Co., Washington); 77, *M. p. procus* (Washoe Co., Nevada); 78, *M. p. muiri*.

per, and the ventrolateral lobe of sternum VIII is evenly convex.

FEMALE: Both *M. weaveri* and *M. spenceri* have a sinus on the posterior margin of sternum VII and the bulga is not compressed. However, in *M. spenceri* there are 3 antepygidial bristles per side; segment V of the labial palp is less than 300 microns in length and the hilla is less than 40 microns in width.

DISTRIBUTION.— CALIFORNIA: Siskiyou County. CANADA: British Columbia.

MATERIAL EXAMINED.— CALIFORNIA: (Siskiyou Co.) 1 ♂, 1 ♀, ex *Neotoma cinerea*, Thunderbolt Cave, 8-V-1975, Nelson and Smith.

DISCUSSION.— *Megarathroglossus spenceri* has been collected in British Columbia and California from *Neotoma cinerea*. The distribution of this flea is undoubtedly greater than that indicated by existing records. *Megarathroglossus pygmaeus*, described by Wagner (1936), was reduced to the status of a junior synonym of *M. spenceri* by Holland (1976) after he examined male and female specimens collected from Siskiyou Co., California, by Nelson and Smith. As the first revisor, Holland (1949) selected *spenceri* as the valid name because it has line priority over *pygmaeus*.

Megarathroglossus weaveri Eads & Campos

Figs. 46, 58, 71, 95, 101

Megarathroglossus weaveri Eads and Campos, 1977.

TYPE HOST.— Not designated (probably *Neotoma mexicana*).

TYPE LOCALITY.— Weaver Ranch, Larimer County, Colorado, at elevations of 1696–1768 meters.

TYPE SPECIMENS.— United States National Museum, Washington, D.C.

DIAGNOSIS.— MALE: *Megarathroglossus weaveri* resembles *M. bisetis* in that both usually possess 2 antepygidial bristles per side and the posterior margin of sternum VIII is evenly convex. However, in *M. weaveri* the inner fovea of the immovable process is greater than 35 microns below the dorsal margin; segment V of the labial palp is more than 220 microns in length; the spur of the crochet is less than 10 microns; the movable process of the clasper is more than 120 mi-

crons in length; and metatarsal segment I is more than 220 microns in length.

FEMALE: *M. weaveri* and *M. spenceri* resemble each other in that both have a sinus in the posterior margin of sternum VII, and the bulga is not compressed. In *M. weaveri* there are two antepygidial bristles per side, segment V of the labial palp is less than 300 microns in length, and the hilla is less than 40 microns in width.

DISTRIBUTION.— COLORADO: El Paso and Larimer counties.

MATERIAL EXAMINED.— COLORADO: (El Paso Co.) 1 ♂, 1 ♀, ex *Neotoma mexicana*, Fort Carson, 7-X-1977, USAEHA; 1 ♂, same host, same location, 8-X-1977, USAEHA; 1 ♂, same host, same location, 12-X-1977, USAEHA; 1 ♂, same host, same location, 13-X-1977, USAEHA; 1 ♂, 4 ♀, same host, same location, 14-X-1977, USAEHA; 2 ♂, 1 ♀, same host, same location, 16-X-1977, USAEHA; (Larimer Co.) 1 ♀, paratype, ex *Neotoma mexicana*, Weaver Ranch, 30-X-1973, Campos (CDC); 1 ♂, paratype, same host, same location, 25-XI-1974, Campos (CDC).

DISCUSSION.— *Megarathroglossus weaveri* has been collected in El Paso and Larimer counties, Colorado, from *Neotoma mexicana* and *Peromyscus maniculatus*. *Megarathroglossus wilsoni* has been collected from the same locations as *M. weaveri*. Additional collections and the ecological and taxonomic relationships between *M. wilsoni* and *M. weaveri*.

Megarathroglossus wilsoni Mendez & Haas

Figs. 43, 55, 75, 96, 100

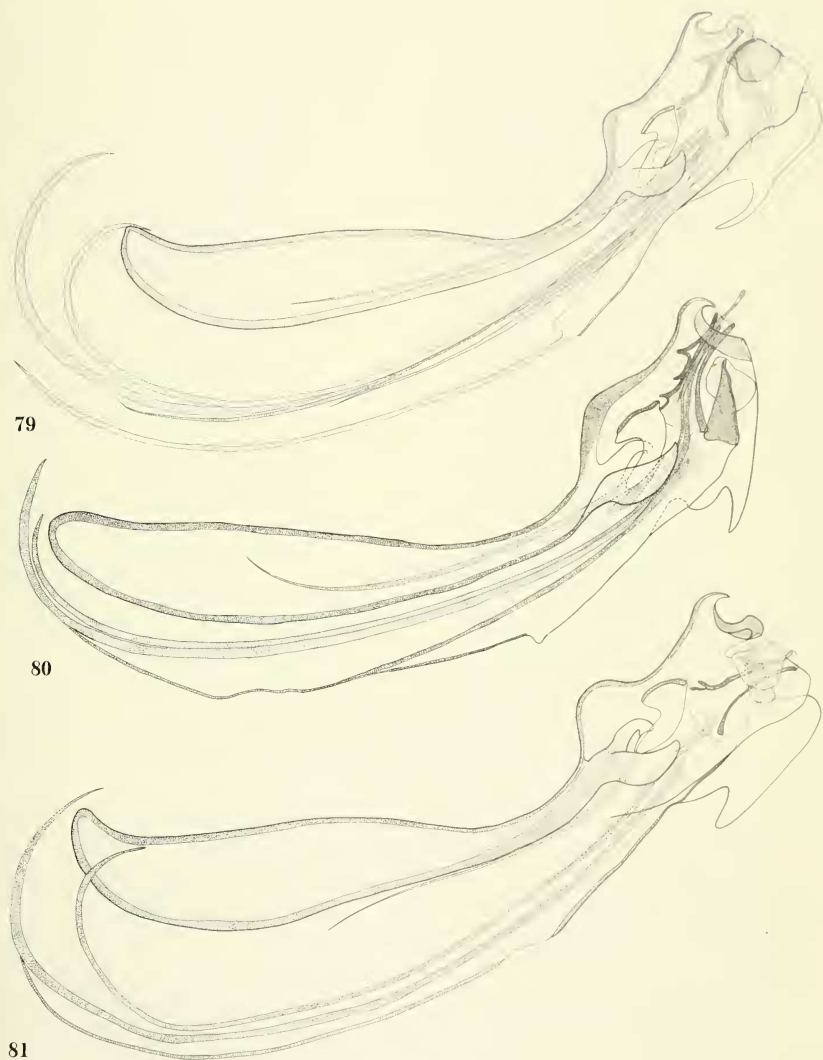
Megarathroglossus wilsoni Mendez and Haas 1973: 1132.

TYPE HOST.— *Peromyscus* sp. and *P. maniculatus*.

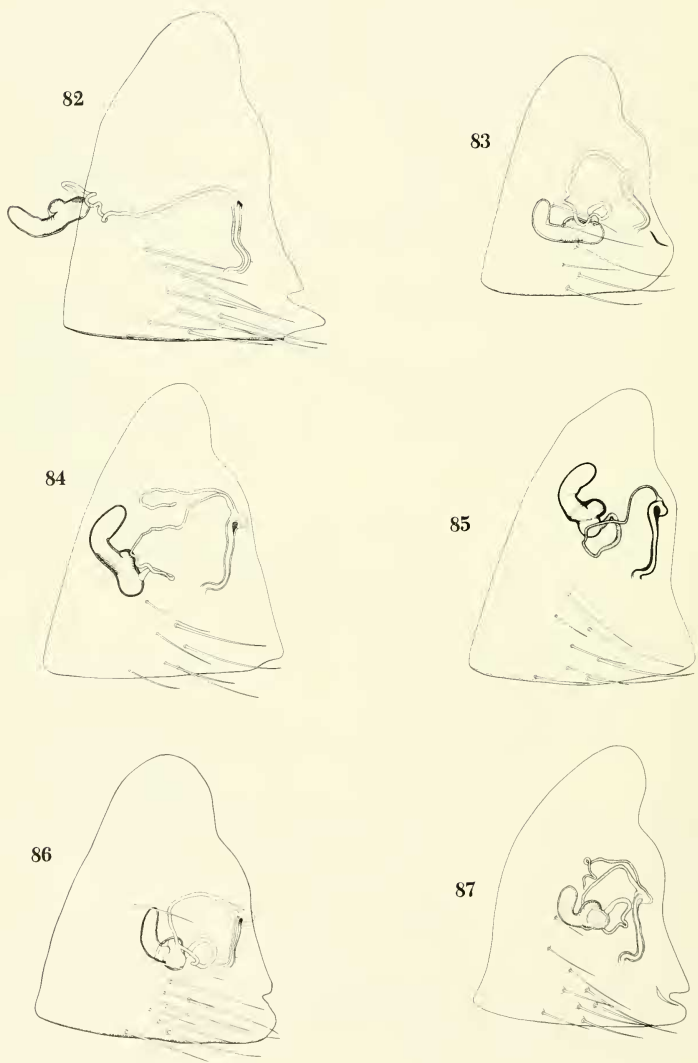
TYPE LOCALITY.— Brigham Hills, Larimer Co., Colorado.

TYPE SPECIMENS.— United States National Museum, Washington, D.C.

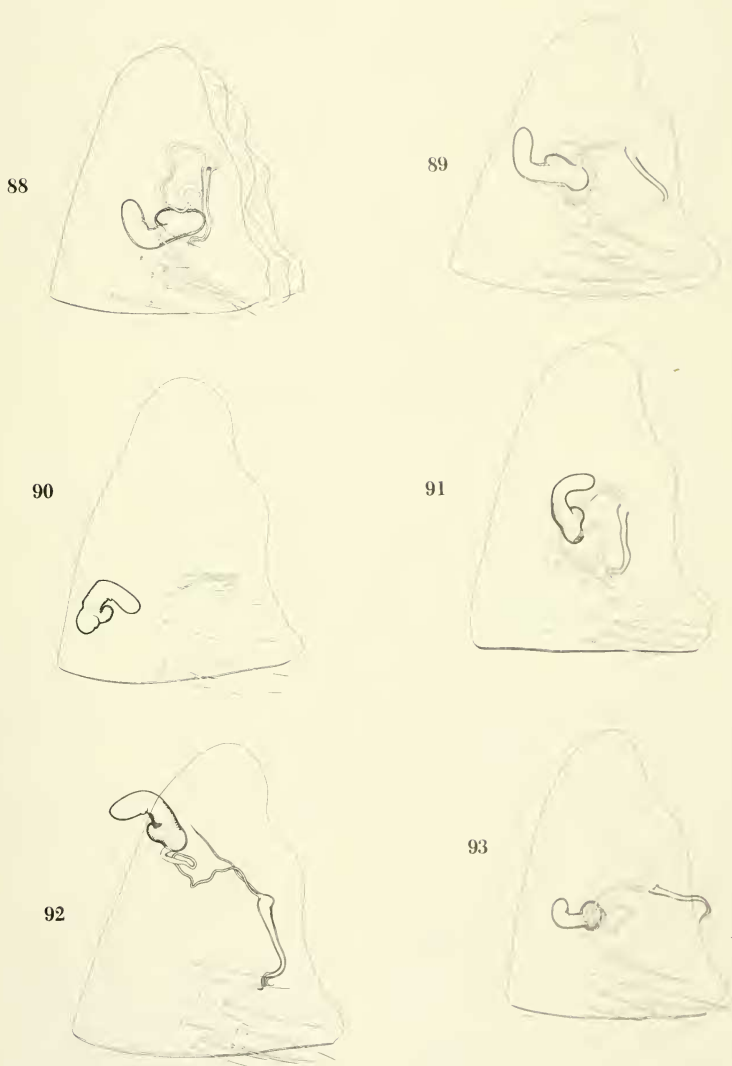
DIAGNOSIS.— MALE: *Megarathroglossus wilsoni* and *M. divisus* are similar, but *M. wilsoni* is different from all other *Megarathroglossus* males in possessing a long inner fovea on the immovable process. *Megarathroglossus wilsoni* may be further separated from *M. di-*



Figs. 79-81. Males, aedeagus; 79, *Megarhroglossus smiti*; 80, *M. spenceri*; 81, *M. sicamus*.



Figs. 82-87. Females, sternum VII; 82, *Megarthroglossus becki*; 83, *M. cavernicolus*; 84, *M. jamesoni*; 85, *M. bisetis*; 86, *M. divisus* (Wayne Co., Utah); 87, *M. divisus* (Ravalli Co., Montana).

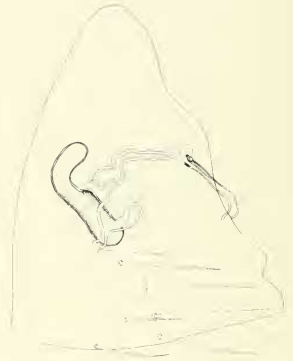


Figs. 88-93. Females, sternum VII: 88, *Megarthroglossus procus procus* (Whatcom Co., Washington); 89, *M. p. procus* (Eldorado Co., California); 90, *M. p. muiri*; 91, *M. sicamus*; 92, *M. sicrae*; 93, *M. smiti*

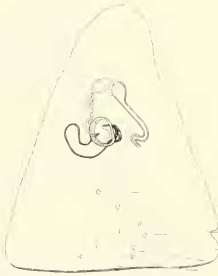
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99



Figs. 94-99. Females, sternum VII; 94, *Megarthroglossus spenceri*; 95, *M. ucaveri*; 96, *M. wilsoni*; 97, *Callistopsyllus terinus deucrus*; 98, *C. t. campestris*; 99, *C. t. terinus*.

cisus in that the inner fovea of the immovable process is more than 40 microns below the dorsal margin, the crochet spur is more than 60 microns in length, and segment V of the labial palp is less than 170 microns in length.

FEMALE: *M. wilsoni* resembles *M. divisus* and *M. becki*. In *M. wilsoni* the sternum VII sinus depth to width ratio is less than 2.40; segment V of the labial palp is less than 260 microns (average length). There are seven spines per side in the pronotal comb, the hilla is less than 35 microns in width, the hilla ratio exceeds 1.20, and the bulga ratio exceeds 1.80.

DISTRIBUTION.—COLORADO: El Paso and Larimer counties. NEW MEXICO: Colfax County.

MATERIAL EXAMINED.—COLORADO: (El Paso Co.) 1 ♀, ex *Neotoma mexicana*, Fort Carson, 13-X-1977, USAEHA; 1 ♂, ex *Peromyscus maniculatus*, same location, 17-X-1977, USAEHA; (Larimer Co.) 1 ♂, paratype, ex *Peromyscus maniculatus*, College Lake, Fort Collins, 29-X-1971, CDC; 1 ♀, paratype, ex *Peromyscus* sp., Bingham Hills, Fort Collins, 24-X-1969, CDC. NEW MEXICO: (Colfax Co.) 1 ♂, paratype, ex *Eutamias minimus* nest in woodpecker hole in dead aspen, SE Red River Pass, Highway 38, 2925 m, 28-VIII-1971, Haas and Wilson (CDC).

DISCUSSION.—*Megarhoglossus wilsoni* has been collected in El Paso and Larimer counties, Colorado, and Colfax County, New Mexico, from species of *Peromyscus*, *Eutamias*, and *Neotoma*. Again, additional data are required to determine host associations and the taxonomic relationship between *M. weaveri* and *M. wilsoni*.

STENISTOMERA Rothschild

Stenistomera Rothschild 1915:307; Ewing 1929:174; Good 1942:132-133; Jellison and Good 1942:132; Ewing and Fox 1943:73; Hubbard 1947:274-304; Holland 1949b:48, 96; Traub and Tipton 1951:267, 268; Jellison, Locker, and Bacon 1953:186; Hopkins 1957:64-87; Hopkins and Rothschild 1962:249; Holland 1965:1052; Jellison and Glesne 1967:300; Egoscue 1968:138; Traub 1968:375-404; Jellison and Senger 1973:70; Lewis 1974:155.

Rothschild (1915) based the genus *Stenistomera* on *Typhlopsylla alpina* Baker (1895). Good (1942) described *macroductyla* and

considered the two known species sufficiently distinct to warrant division of the genus into two subgenera and consequently he described the subgenus *Miochaeta* to contain *macroductyla*. These subgenera were distinguished from each other on the basis of the helmet-shaped head in *S. alpina* on which there are several spinelike bristles. Stark (1958) elevated the subgenus *Miochaeta* to generic level on the basis of these characteristics. Egoscue (1968) described a new species, *hubbardi*, which he claimed to be intermediate between *alpina* and *macroductyla* "and makes recognition of the subgenera erected by Good and the genus *Miochaeta* as proposed by Stark untenable." We concur with the evaluation of Egoscue.

DIAGNOSIS.—*Stenistomera* has a readily discernible interantennal groove. The eye is absent and the labial palp is 4-segmented as in *Callistopsyllus* and *Anomiopsyllus*. However, the latter genus does not have a pronotal comb. The mesocoxa has an incomplete longitudinal break that extends for less than one-half the diagonal distance. *Stenistomera* has a comb of dorsolateral bristles on the mesotibia and *Callistopsyllus* does not. In addition, the bristles of the head are more numerous and prominent in *Stenistomera* than in other genera of the subfamily.

DESCRIPTION.—HEAD: Anterior margin convex, angulate or helmet shaped; numerous stout (spiniform in *alpina*) marginal and submarginal bristles; pores and placoids scattered over frons and occiput, but mostly submarginal. Eye absent. Antenna extremely short. Maxillary lobe reduced, angulate. Maxillary palp 4-segmented, short, extends to midpoint on forecoxa. Labial palp well developed, 4-segmented, extends to apex of forecoxa, apex more or less asymmetrical.

THORAX: Pronotal comb of 16-18 teeth. Lateral metanotal area absent. Pleural areh absent. Metepisternum fused with metasternum. Hind coxa narrow, false combs on mesotibiae, four pairs lateral bristles on fifth tarsal segment.

ABDOMEN: One row of bristles on each abdominal tergum. Three antepygidial bristles in both sexes.

MODIFIED ABDOMINAL SEGMENTS—MALE: Fixed process of clasper not well developed; movable process long, narrow, with sides sub-

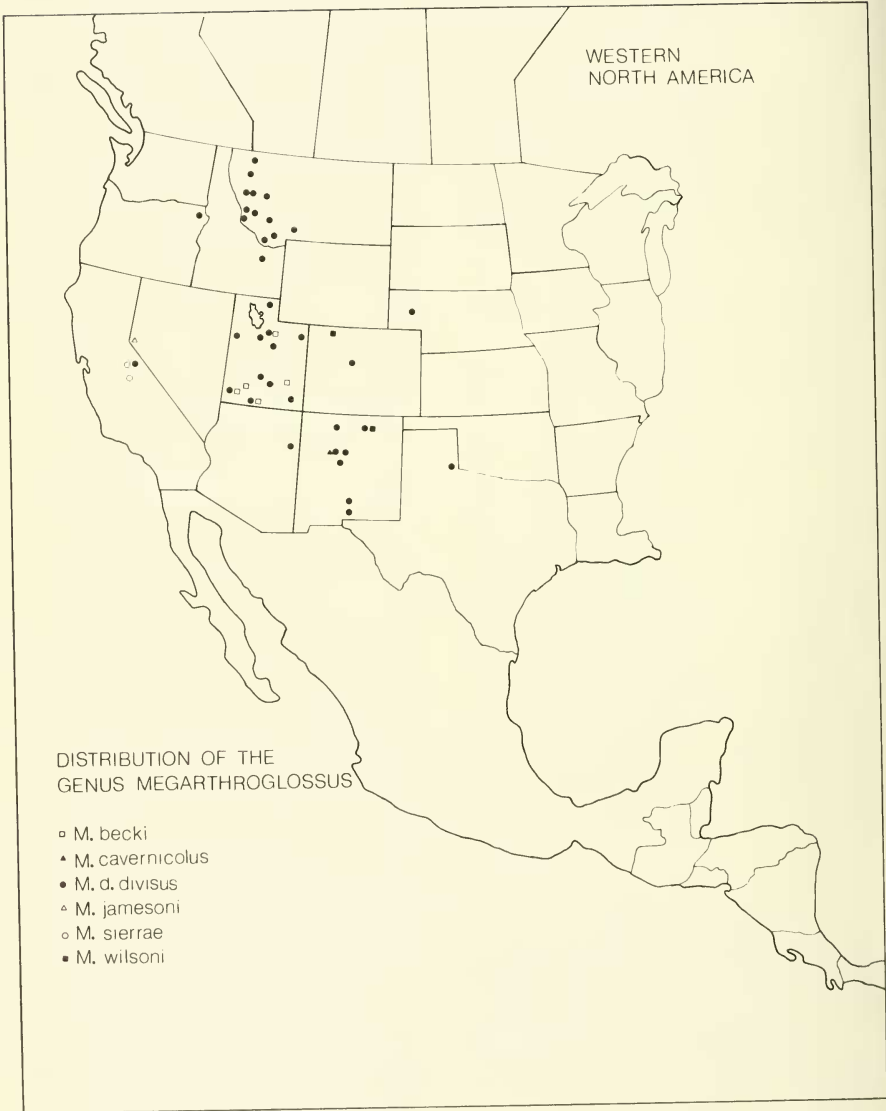


Fig. 100. Distribution of *Megarhroglossus* species: *M. becki*, *M. cavernicolus*, *M. divisus*, *M. jamesoni*, *M. sierrae*, and *M. wilsoni*.

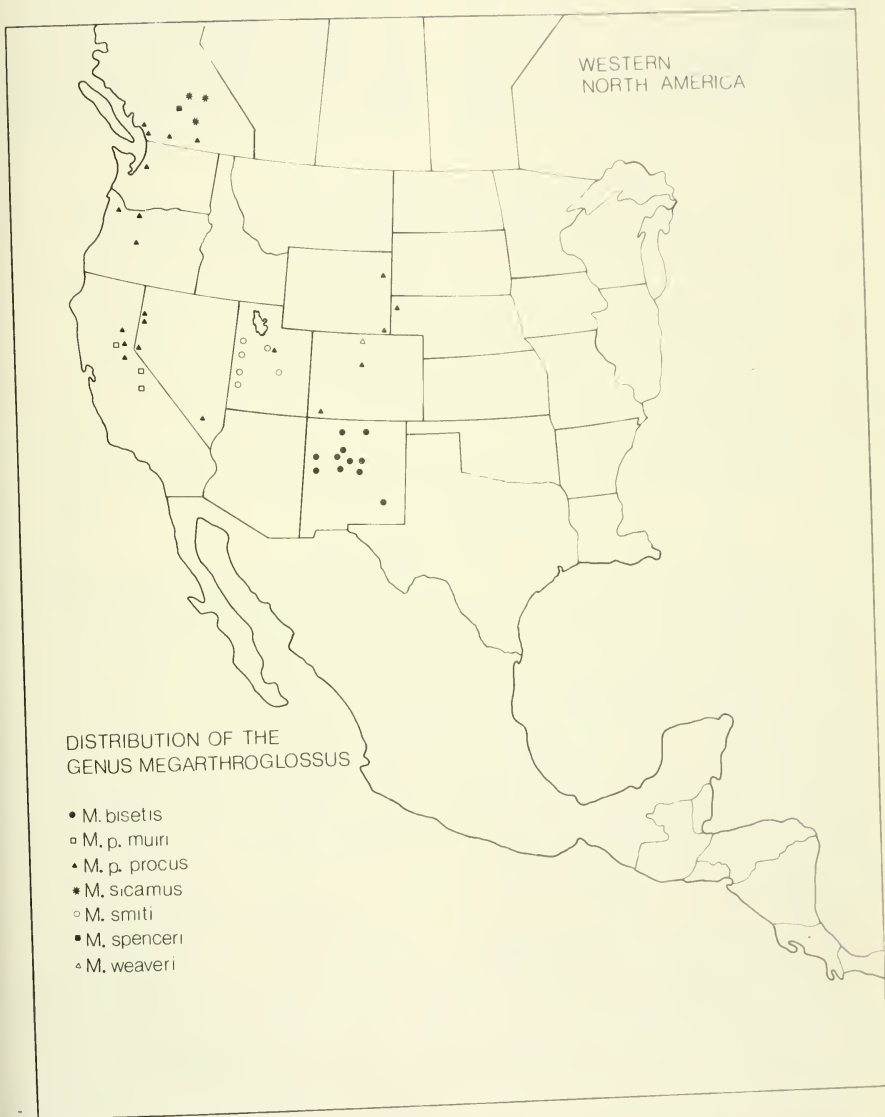


Fig. 101. Distribution of *Megarhroglossus* species: *M. bisetis*, *M. p. muiri*, *M. p. procus*, *M. sicamus*, *M. smiti*, *M. spenceri*, and *M. weaveri*.

parallel, apex truncate; with two well-pigmented, spiniform, apical or subapical setae. Sternum IX with narrow proximal arm but with subapical portion swollen; distal arm expanded, bearing subapical spiniform(s) plus several small marginal and submarginal setae. Aedeagus with narrow, saberlike apodeme, with long-coiled appendage; apodemal rods

long, coiled. Crescent sclerite and capsule prominent. Median dorsal lobe well sclerotized, apex somewhat hooklike.

MODIFIED ABDOMINAL SEGMENTS—FEMALE: Posterior margin of sternum VII convex dorsally, with ventral sinus. Bulga of spermatheca barrel shaped; hilla bent at right angles to bulga.

Key to the Species of *Stenistomera* (Male)

1. Process of clasper broader than distal arm of sternum IX at its widest point (Fig. 107); two spiniform bristles on caudal margin separated by more than 3 times length of one spiniform; distal arm of sternum IX with apex subacuminate (Fig. 104) *macroductyla*
- Process of clasper narrower than distal arm of sternum IX at its widest point; two spiniform bristles on caudal margin separated by less than 3 times length of one spiniform, distal arm of sternum IX with apex subacuminate to subtruncate 2
- 2(1). Distal arm of sternum IX with two prominent subapical bristles; apex subacuminate (Fig. 105) *hubbardi*
- Distal arm of sternum IX with one prominent subapical bristle; apex subtruncate (Fig. 103) *alpina*

Stenistomera hubbardi Egoscue

Figs. 28, 105, 108, 109, 114, 115

Stenistomera hubbardi Egoscue 1968:138-142; Lewis 1974:155.

TYPE HOST.—*Peromyscus maniculatus* ssp.

TYPE LOCALITY.—Crane, Harney Co., Oregon.

TYPE SPECIMENS.—United States National Museum, Washington, D.C.

DIAGNOSIS.—The labial palp extends for three-fourths the length of the procoxa and the maxillary lobe is subacuminate. The pre-antennal bristles are larger and heavier than in *S. macroductyla*, but less so than in *S. alpina*.

DESCRIPTION.—MALE: Movable process of clasper elongate, rectangular, curved slightly caudad, distal one-third with two spiniforms on caudal margin. Base of acetabular bristle midway between sensillial plate and articulation of movable process of clasper. Distal portion of sternum IX blade shaped, with two thick, blunt, subapical bristles.

FEMALE: Three antepygial bristles approximately equal in length; anal stylet long, about four times longer than wide, with long

subapical bristle plus shorter apical bristle. Bulga of spermatheca not markedly dissimilar in shape from that of other members in genus or in *Callistopsyllus terinus*; hilla sharply bent (approximately 90 degrees) shortly after exiting from bulga, apex with prominent sclerotized papilla.

DISTRIBUTION.—OREGON: Harney County.

MATERIAL EXAMINED.—OREGON: (Harney Co.) 1 ♂, 1 ♀ and 1 broken specimen, ex *Peromyscus maniculatus*, 8.0 km south of Crane, 23-X-1966, H. J. Egoscue.

Stenistomera macroductyla Good

Figs. 29, 104, 107, 110, 113, 115

Stenistomera macroductyla Good 1943:135; Hubbard 1947:306; Jellison, Locker, and Bacon 1953:186; Holdenried and Morlan 1955:133-137; Morlan 1955:93-125; Wiseman 1955:1-18; Parker and Howell 1959:597-604; Hopkins and Rothschild 1962:353-354; Beck 1966:77; Jellison and Glesne 1969:302; Allred 1968:78; Egoscue 1968:140; Tipton and Saunders 1971:18; Haas et al. 1973:282; Pratt and Stark 1973:11; Lewis 1974:155; Egoscue 1976:476.

Miochaeta macroductyla Stark 1959:104.

TYPE HOST.—*Peromyscus eremicus*.

TYPE LOCALITY.—Mojave Co., Arizona.

TYPE SPECIMENS.—United States Public Health Service Plague Laboratory, San Francisco, California.

DIAGNOSIS.—Labial palp extends to apex of the procoxa. Maxillary lobe is subacuminate, but broader at the apex than in *S. hubbardi*. The preantennal bristles are not enlarged or heavily pigmented as in *S. hubbardi* or *S. alpina*.

TABLE 7. Distribution of species of *Stenistomera*.

AREA	<i>S. alpina</i>	<i>S. hubbardi</i>	<i>S. macrodactyla</i>
Arizona	X		
Colorado	X		X
Idaho	X		X
Montana	X		
Nevada	X		X
New Mexico	X		X
Oregon	X	X	
Utah	X		X
Wyoming	X		X
British Columbia	X		

TABLE 8. Host associations of the genus *Stenistomera*.

Host species	<i>S. alpina</i>	<i>S. hubbardi</i>	<i>S. macrodactyla</i>
<i>Amnospermophilus leucurus</i>	X		
<i>Lyx rufus pallescens</i>	X		
<i>Neotoma albigula</i>	X		
<i>Neotoma albigula albigula</i>	X		
<i>Neotoma cinerea</i>	X		X
<i>Neotoma cinerea acraia</i>	X		
<i>Neotoma cinerea alticola</i>	X		
<i>Neotoma lepida</i>	X		
<i>Neotoma lepida lepida</i>	X		
<i>Neotoma lepida nevadensis</i>	X		
<i>Neotoma mexicana</i>	X		
<i>Peromyscus crinitus</i>	X		X
<i>Peromyscus crinitus pergracilis</i>	X		
<i>Peromyscus maniculatus</i>		X	X
<i>Peromyscus maniculatus sonoriensis</i>	X		
<i>Reithrodontomys megalotis megalotis</i>	X		
<i>Urocyon cinereogargentus</i>	X		
<i>Spilogale putorius sayatilis</i>	X		

DESCRIPTION.—MALE: Movable process of clasper elongate, urn shaped, not curved caudad as in *S. hubbardi* or *S. alpina*, with two widely separated spiniforms on caudomesal surface. Base of acetabular bristle near articulation of movable process of clasper. Distal arm of sternum IX narrow at apex, with single thick, blunt subapical bristle.

FEMALE: Three antepygidial bristles of about equal length. Anal stylet long, (about three to four times as long as wide), with row of four ventral marginal bristles of about equal length (variable, usually two to five), one long subapical bristle, plus one short apical bristle. Caudal margin of sternum VII with dorsal portion evenly convex, short subacuminate to triangular ventral lobe ventral to broad, shallow sinus. Bulga typically shaped; hilla evenly curved dorsad, lacks sclerotized papilla as in *S. hubbardi*.

DISTRIBUTION.—COLORADO: Montezuma County. IDAHO: Bingham and Butte counties. NEVADA: Washoe County. NEW MEXICO: Sandoval County. UTAH: Daggett, Iron, San Juan, Tooele, and Uintah counties. WYOMING: Sweetwater County.

MATERIAL EXAMINED.—COLORADO: (Montezuma Co.) 1 ♂, 3 ♀, ex *Peromyscus maniculatus*, Mesa Verde National Park, 26-V-1962, C. Douglas (BYU). IDAHO: (Bingham Co.) 1 ♀, ex *Peromyscus maniculatus*, AEC-NRTS (19Y), 22-IX-1966 (BYU); 3 ♀, same host, AEC-NRTS (21-S), 18-IX-1966 (BYU); 1 ♀, same host AEC-NRTS (21S), 20-XI-1966 (BYU); 1 ♂, 2 ♀, same host, AEC-NRTS (33Y), 17-XI-1967 (BYU); 1 ♂, 1 ♀, ex rodent nest, same location, same date (BYU); 14 ♂, 5 ♀, ex *Peromyscus maniculatus*, AEC-NRTS (33Y), 19-XI-1967 (BYU); 1 ♂, ex *Neotoma cinerea*, AEC-NRTS (33Y), 22-VIII-1967 (BYU); (Butte Co.) 3 ♀, ex *Peromyscus maniculatus*, AEC-NRTS (31Y), 16-I-1967 (BYU); 1 ♂, same host, AEC-NRTS (32Y) 17-XI-1967 (BYU). UTAH: (Daggett Co.) 1 ♂, 1 ♀, ex *Peromyscus maniculatus*, Linwood, 14-VII-1954, C. L. Hayward (BYU); (Iron Co.) 1 ♂, same host, Parowan, 4-IX-1951, Beck and Allred (BYU); (San Juan Co.) 2 ♀, same host, Bluff, 5-V-1951, D. E. Beck (BYU), 1 ♀, same host, Montezuma Creek, 7-VI-1955, Beck et al. (BYU); (Uintah Co.) 1 ♂, 1 ♀, ex *Peromyscus crinitus*, Jensen, 8-XI-1952, Beck and Beck (BYU).

Stenistomera alpina (Baker)

Figs. 30, 38, 102, 103, 106, 111, 112, 115

Typhlopsylla alpina Baker 1895:189, 191.*Ctenopsylla alpina* Wagner 1898:577-578.*Ctenopsyllus alpinus* Baker 1904:427, 452; Triaboschi 1904:285.

Stenistomera alpina Rothschild 1915:307; C. Fox 1925:127; Wagner 1930:144; Stanford 1931:153; Wagner 1939:32; Eskey and Haas 1940:29, 74; Good 1942:133; Jellison and Good 1942:132; Ewing and Fox 1943:73; Hubbard 1943:1-12; Jellison, Khols, and Mills 1943:1-22; Stanford 1944:175; Hubbard 1947:305; Hubbard 1949:121; Tipton 1950:65; Traub and Hoff 1951:23 pp.; Holland 1952:65-73; Wehrle 1953:37-41; Jellison, Locker, and Bacon 1953:186-187; Augustson 1955:36-39; Morlan 1955:93-125; Wiseman 1955:1-23; Holdenried and Morlan 1956:369-381; Finley 1958:213-552; Parker and Howell 1959:597-604; Stark 1959:103; Hopkins and Rothschild 1962:350-353; Beck and Hoff 1966:13; Jellison and Glesne 1967:300-301; Allred 1968:78; Egoscue 1968:140; Tipton and Saunders 1971:18; Pratt and Stark 1973:11; Haas et al. 1973:282; Jellison and Senger 1973:71; Lewis 1974:155; Egoscue 1976:475-488.

Delotelis mohavensis Augustson 1942:138; Augustson 1943:86.

TYPE HOST.— Mountain rat (probably *Neotoma cinerea*).

TYPE LOCALITY.— Georgetown, Clear Creek Co., Colorado.

TYPE SPECIMENS.— United States National Museum, Washington, D.C.

DIAGNOSIS.— Labial palp extends beyond the apex of the procoxa and usually beyond the trochanter; the maxillary lobe is acuminate and the preantennal bristles are thick and heavily pigmented; some are spiniformlike.

DESCRIPTION.— MALE: Movable process of clasper elongate, curved slightly caudad, with two closely spaced spiniforms on meso-caudal margin, similar to that of *S. hubbardi*. Base of acetabular bristle displaced toward sensillary plate as in *S. hubbardi*, but less so than in *S. macrodactyla*. Distal arm of sternum IX somewhat similar to *S. hubbardi*, but with single, thick, blunt bristle to caudoventral angle, apex subtruncate.

FEMALE: Three antepygial bristles, middle bristle longest. Anal stylet long, three to four times as long as wide, usually with two ventral bristles, one long subapical bristle plus short apical bristle. Bulga typical, but with a slight narrowing at end near hilla; no sclerotized papilla on hilla.

DISTRIBUTION.— ARIZONA: Apache, Cochise, and Coconino counties. COLORADO: Clear Creek and El Paso counties. IDAHO: Butte County. MONTANA: Custer, Madison, and Ra-

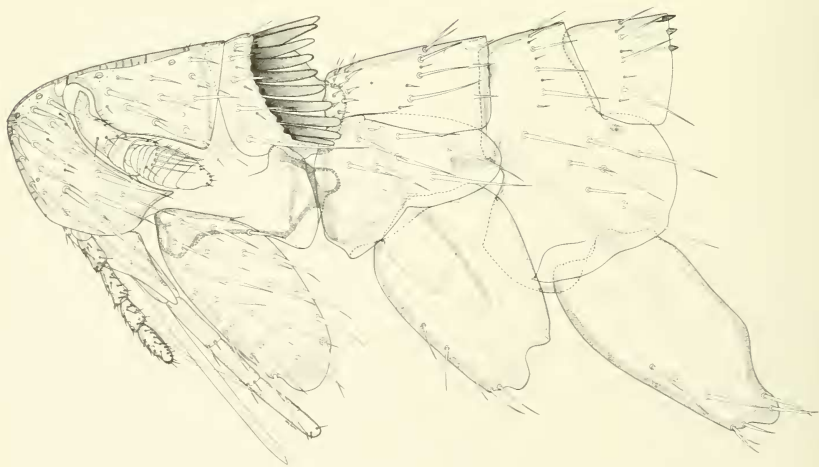


Fig. 102. *Stenistomera alpina* (Baker): Male, head and thorax including coxae.

valli counties. NEVADA: Nye and Washoe counties. NEW MEXICO: Chaves, Bernalillo, and Sandoval counties. OREGON: Harney County. UTAH: Cache, Kane, Juab, Salt Lake, San Juan, Sanpete, Sevier, Tooele, and Utah counties. WYOMING: Albany and Sweetwater counties. CANADA: Alberta.

MATERIAL EXAMINED.—ARIZONA: (Cochise Co.) 1 ♀, ex *Neotoma mexicana*, 0.8 km E Buena Vista Park., Chiricahua Mts., 23-XI-1957, C. E. Ordway (BYU). IDAHO: (Butte Co.) 7 ♂, 5 ♀, ex *Neotoma cinerea*, AEC-NRTS (29), 15-XII-1966 (BYU). NEVADA: (Nye Co.) 1 ♂, 3 ♀, ex *Peromyscus crinitus*, Mercury, AEC-NRTS, 6-XII-1961 (BYU); 1 ♂, 5 ♀, ex *Neotoma lepida*, same location, 11-XII-1960 (BYU); 2 ♂, 11 ♀, same host, same location, 9-XII-1961 (BYU); 6 ♂, 19 ♀, same host, same location, 11-XII-1961 (BYU); 1 ♂, 3 ♀, same host, same location, 8-XI-1961 (BYU); 2 ♂, 2 ♀, ex *Neotoma albigula*, same location, 28-X-1961 (BYU); 13 ♂, 35 ♀, ex *Neotoma lepida*, same location, 6-XII-1961 (BYU); 1 ♂, ex *Ammospermophilus leucurus*, same location, 7-XII-1961; 1 ♀, ex *Neotoma lepida*, same location, 16-XI-1961 (BYU); 1 ♂, 2 ♀, same host, same location, 11-XI-1961 (BYU); 22 ♂, 37 ♀, same host, same location, 17-XII-1961 (BYU); 1 ♂, 2 ♀, same host, same location, 5-I-1962 (BYU); 4 ♂, 11 ♀, same host, same location, 20-XII-1961 (BYU); 1 ♂, same host, same location, 7-I-1962 (BYU); 1 ♂, same host, same location, 2-I-1962 (BYU); 1 ♂, same host, same location, 2-I-1962 (BYU); 7 ♂, 13 ♀, same host, same location, 17-XII-1961 (BYU); 1 ♂, 1 ♀, ex *Neotoma lepida lepida*, Beatty, 27-XII-1947, C. A. Hubbard (BYU); 27-XII-1947, C. A. Hubbard (BYU). NEW MEXICO: (Bernalillo Co.) 1 ♂, 1 ♀, ex *Neotoma a. albigula*, 28.8 km E Albuquerque, 6-III-1949, H. H. Lewis (BYU). UTAH: (Kane Co.) 1 ♂, 2 ♀, ex *Urocyon cinereoargenteus*, NAV-KAI, 14-XI-1971 (BYU); 1 ♀, ex *Peromyscus crinitus*, same location, 11-XII-1971 (BYU); (Juab Co.) 8 ♂, 24 ♀, ex *Neotoma lepida lepida*, Topaz Mt., 19-I-1964 (Egoscue); 5 ♂, 12 ♀, same host, same location, 20-I-1964 (Egoscue); 4 ♂, 13 ♀, same host, Fish Springs, I-XII-1964 (Egoscue); 1 ♂, ex *Reithrodontomys megalotis megalotis*, same location, 1-XII-1964 (Egoscue); 1 ♀, ex *Peromyscus maniculatus sonoriensis*, Callao, 26-I-1965 (Egoscue); (San

Juan Co.) 2 ♂, ex *Neotoma cinerea*, S Moab, 8-V-1951, Allred and Myklebust (BYU); (Tooele Co.) 2 ♂, 1 ♀, ex *Lyxix rufus pallescens*, 9.6 km E Granite Mt., 1300 m, 5-III-1965, H. J. Egoscue (Egoscue); 1 ♂, ex *Neotoma lepida lepida*, granite outcrops, E Granite Mt., 1380 m 19-XI-1965, H. J. Egoscue (Egoscue); 5 ♂, same host, same location, same elevation, 13-I-1966, H. J. Egoscue (Egoscue); 2 ♂, 5 ♀, same host, same location, same elevation, 18-I-1966, H. J. Egoscue (Egoscue); 5 ♂, 8 ♀, same host, same location, same elevation, 24-III-1966, H. J. Egoscue (Egoscue); 6 ♀, same host, same location, same elevation, 9-III-1966, H. J. Egoscue (Egoscue); 3 ♂, same host, same location, same elevation, 15-III-1966; H. J. Egoscue (Egoscue); 4 ♀, 2 ♂, same host, same location, same elevation, 25-II-1966, H. J. Egoscue (Egoscue); 2 ♂, same host, same location, same elevation, 2-III-1966; H. J. Egoscue (Egoscue); 1 ♂, same host, same location, same elevation, 19-XI-1965, H. J. Egoscue (Egoscue); 1 ♂, same host, same location, same elevation, 19-II-1966, H. J. Egoscue (Egoscue); 1 ♂, 3 ♀, same host, same location, same elevation, 17-II-1966, H. J. Egoscue (Egoscue); 1 ♂, 1 ♀, same host, same location, same elevation, 17-XI-1965, H. J. Egoscue (Egoscue); 1 ♂, 3 ♀, same host, same location, same elevation, 13-I-1966, H. J. Egoscue (Egoscue); 2 ♂, 1 ♀, ex *Peromyscus crinitus pergracilis*, same location, same elevation, 12-I-1966, H. J. Egoscue (Egoscue); 1 ♂, same host, same location, same elevation, 16-III-1966, H. J. Egoscue (Egoscue); 1 ♀, same host, same location, same elevation, 18-I-1966, H. J. Egoscue (Egoscue); 1 ♀, same host, same location, same elevation, 11-I-1966, H. J. Egoscue (Egoscue); 1 ♂, 2 ♀, ex *Spilogale putorius sayatilis*, same location, same elevation, 19-I-1966, H. J. Egoscue (Egoscue); 1 ♂, 6 ♀, ex *Peromyscus crinitus pergracilis*, Little Granite Mt., 1440 m, 6-XII-1961, H. J. Egoscue (Egoscue); 1 ♂, 2 ♀, ex *Neotoma lepida lepida*, same location, same elevation, 6-XII-1966, H. J. Egoscue (Egoscue); 1 ♂, 2 ♀, same host, same location, same elevation, 8-XII-1966, H. J. Egoscue (Egoscue); 1 ♂, 1 ♀, same host, same location, same elevation, 14-XII-1966, H. J. Egoscue (Egoscue); 8 ♂, 7 ♀, same host, same location, same elevation, 15-XII-

1966, H. J. Egoscue (Egoscue); 1 ♂, 2 ♀, same host, same location, same elevation, 20-XII-1966, H. J. Egoscue (Egoscue); 4 ♂, 4 ♀, same host, same location, same elevation, 21-XII-1966, H. J. Egoscue (Egoscue); 4 ♂, 10 ♀, same host, same location, same elevation, 6-I-1967, H. J. Egoscue (Egoscue); 5 ♂, 4 ♀, same host, same location, same elevation, 25-I-1967, H. J. Egoscue (Egoscue); 1 ♀, ex *Peromyscus maniculatus sonoriensis*, Johnson Pass, 1797 m, 11-III-1969, H. J. Egoscue (Egoscue); 1 ♂, same host, Wendover, 12-XII-1964 (Egoscue); 1 ♀, same host, Lakeside Mts., 16-III-1965 (Egoscue); 2 ♂, 2 ♀, *Neotoma lepida lepida*, Johnson Pass, 1872 m, 23-I-1969, H. J. Egoscue (Egoscue); 1 ♀, same host, Little Granite Mt., 1418 m, 31-I-1963, J. G. Bittmenn (Egoscue); 4 ♀, same host, Wendover, 12-XII-1964 (Egoscue); 1 ♂, 1 ♀, same host, Grassy Mt., 1590 m, 30-XI-1967, H. J. Egoscue (Egoscue); 1 ♂, 2 ♀, same host, W Stansbury Island, 1302 m, 29-II-1968, H. J. Egoscue (Egoscue); 1 ♀, ex *Neotoma c. acraia*, Johnson Pass, 1830 m, 22-I-1969, H. J. Egoscue (Egoscue); 1 ♂, 1 ♀, ex *Peromyscus crinitus pergracilis*, N. Dugway Mr., 1500 m, 27-II-1967, H. J. Egoscue (Egoscue); (Utah Co.) 1 ♀, ex *Neotoma cinerea* nest, Provo, 18-XI-1948, V. J. Tipson (BYU); 1 ♀, same host, Buckley's Mine, Provo, 24-XI-1949, D. M. Allred (BYU); 1 ♂, 3 ♀, ex *Neotoma cinerea* (dung), Rock Canyon, Provo, 11-III-1949, V. J. Tipson (BYU); 1 ♂, 3 ♀, ex *Neotoma cinerea*, Provo Canyon, Provo, 12-XI-1949, H. Goldschmidt (BYU). OREGON: (Harney Co.) 6 ♂, 27 ♀, ex *Neotoma cinerea alticola*, 11.2 km S Crane, 1290 m, 25-XI-1968, H. J. Egoscue (Egoscue); 2 ♀, ex *Neotoma lepida nevadensis*, 8 km S Crane, 1290 m, 25-XI-1968, H. J. Egoscue (Egoscue).

DISCUSSION.—*Stenistomera alpina* has a greater recorded distribution than the other two species of the genus and it probably occurs in all eleven western states. More than 90 percent of the specimens in our collection were associated with *Neotoma lepida* and most of them were collected during winter months. Although there is some slight variation in the location of the spiniforms on the movable process of the clasper, most of our specimens show little variation in characters of taxonomic importance.

COLLECTION DATA FOR SPECIMENS
USED FOR ILLUSTRATIONS

Callistopsyllus terinus campestris Holland: male and female, ex *Peromyscus* sp., Alberta, Canada, 27-V-1949, G. P. Holland (Holland).

Callistopsyllus terinus deuterus Jordan: male and female, ex *Peromyscus truei*, 1.6 km S El Condor, Baja California, Mexico, 31-XII-1962, W. J. Wrenn (Traub).

Callistopsyllus terinus terinus (Rothschild): male and female, ex *Peromyscus maniculatus*, AFC-NRTS, Idaho, 22-III-1967 collectors unknown (BYU).

Conorhinopsylla nidicola Jellison: male and female paratypes, ex *Neotoma* sp. nest, Lawrence, Douglas Co., Kansas, 11-XI-1944, R. H. Beamer (Traub).

Conorhinopsylla stanfordi Stewart: male and female, ex *Glaucomyces colans*, Otsego Co., New York, 6-XII-1956, P. Connors (Benton).

Megarhroglossus becki Tipton and Allred: male and female paratypes, ex *Neotoma cinerea* nest, Buckley's Mine, Provo, Utah Co., Utah, 24-XI-1949, D. M. Allred (BYU).

Megarhroglossus bisetis Jordan and Rothschild: male and female, ex *Neotoma micropus*, Red Bluff Ranch, Chaves Co., New Mexico, 25-V-1967, B. Miller (Lewis).

Megarhroglossus cavernicolus Mendez and Haas: male and female paratypes, ex *Neotoma cinerea* nest, cave W edge Valle Grande, Jemez Mts., Sandoval Co., New Mexico, 18-IX-1970, G. E. Haas et al. (Mendez).

Megarhroglossus divinus (Baker): male and female, ex *Sciurus fremonti* nest, Elkhorn R. S., Wayne Co., Utah, 9-VIII-1952, M. Killpack et al. (BYU).

Megarhroglossus divinus Wagner: male and female, ex packrat (*Neotoma* sp.) nest, 8 mi Creek, Ravalli Co., Montana, 29-XII-1962, C. M. Senger (Senger).

Megarhroglossus jamesoni Smit: male and female, ex *Neotoma cinerea* nest, Pine Nut Mts., Douglas Co., Nevada, 25-III-1951, E. W. Jameson (Jameson).

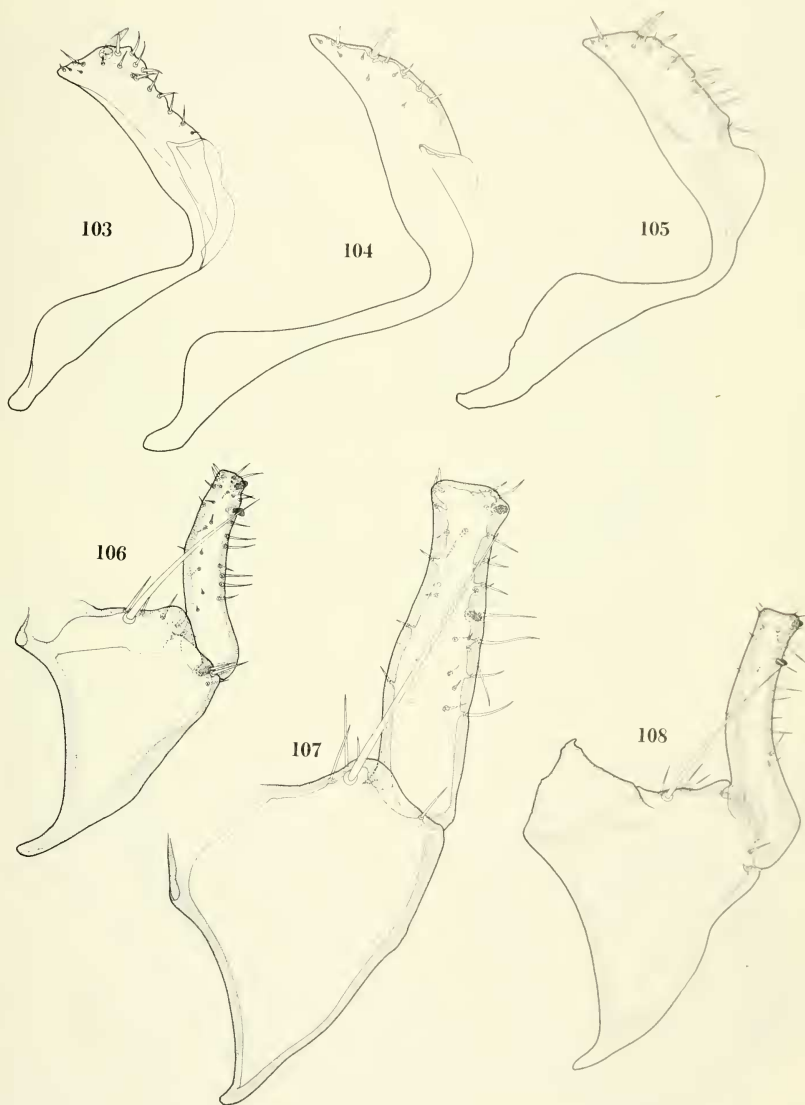
Megarhroglossus procus procus Jordan and Rothschild: male and female, ex packrat (*Neotoma* sp.) nest, Glacier, Whatcom Co., Washington, X-1963, C. M. Senger (Senger).

Megarhroglossus procus procus Jordan and Rothschild: male ex "chipmunk," Washoe Co., Nevada, X-1936, C. R. Eskey; female ex "chipmunk," Eldorado, California, X-1936, C. R. Eskey.

Megarhroglossus procus muiri Augustson: male holotype, ex *Tamiasciurus d. albolimbatus*, Tully's Hole, Fresno Co., California, 25-VIII-1941, G. F. Augustson (Augustson); female allotype, ex *Sorex (Neo.) navigator*, Tully's Hole, Fresno Co., California, 24-VIII-1941, G. F. Augustson (Augustson).

Megarhroglossus sicamus Jordan and Rothschild: male paralectotype, ex *Canis latrans*, Eagle River, Sicamous, British Columbia, Canada, 6-IX-1903, G. F. Dippie (Smit); female ex *Neotoma* sp., Pavilion Lake, British Columbia, Canada, 5-VII-1950, K. B. (Holland).

Megarhroglossus sierrae Augustson: male holotype, ex *Ochotona s. muiri*, Cascade Valley, Fresno Co., California, 27-VIII-1941, G. F. Augustson (Augustson); female allotype, ex *Tamiasciurus d. albolimbatus*, Mammoth Lakes, Mono Co., California, 31-VII-1939, G. F. Augustson (Augustson).



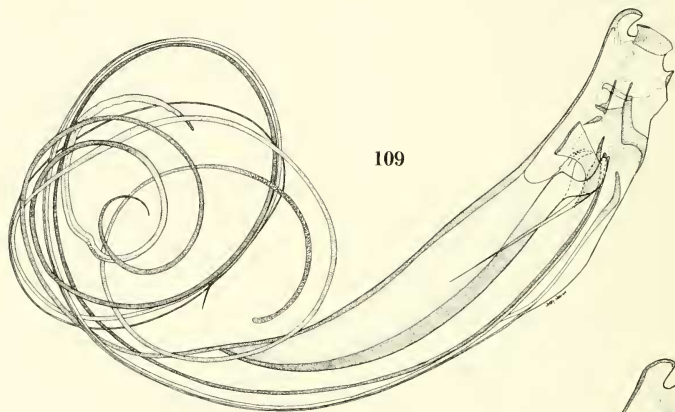
Figs. 103-108. Males, sternum IX; 103, *Stenistomera alpina*; 104, *S. macrodactyla*; 105, *S. hubbardi*; 106-108, claspers; 106, *S. alpina*; 107, *S. macrodactyla*; 108, *S. hubbardi*.

Megarhroglossus spenceri Wagner: male holotype (*Megarhroglossus pygmaeus*), ex *Neotoma cinerea occidentalis*, Nicola, British Columbia, Canada, 25-VIII-1932, collector unknown (Holland); female holotype (*Megarhroglossus spenceri*), ex *Ochotona princeps*, Nicola, British Columbia, Canada, 26-VIII-1932, collector unknown (Holland).

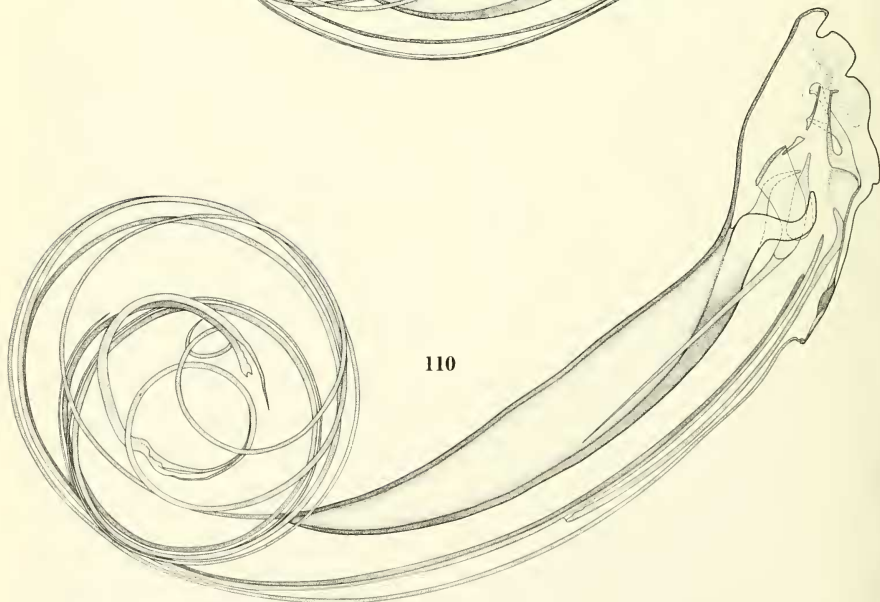
Megarhroglossus smiti Mendez: male and female paratypes, ex *Neotoma lepida*, Lynndyl, Millard Co., Utah, 17-XI-1951, Barnum, Moore, Melander and Cloward (BYU).

Megarhroglossus weaveri Eads and Campos: male and female paratypes, ex *Neotoma mexicana*, Weaver Ranch, Larimer Co., Colorado, 25-XI-1974 and 30-X-1973 (respectively), E. G. Campos (Eads).

Megarhroglossus wilsoni Mendez and Haas: male paratype, ex *Eutamias minimus* nest, 0.8 km SE Red River Pass, Colfax Co., New Mexico, 28-VIII-1971, Haas and Wilson (Mendez); female paratype, ex *Peromyscus maniculatus*, 7.2 km NW Ft. Collins, Larimer Co., Colorado, 29-X-1969, collector unknown (Eads).

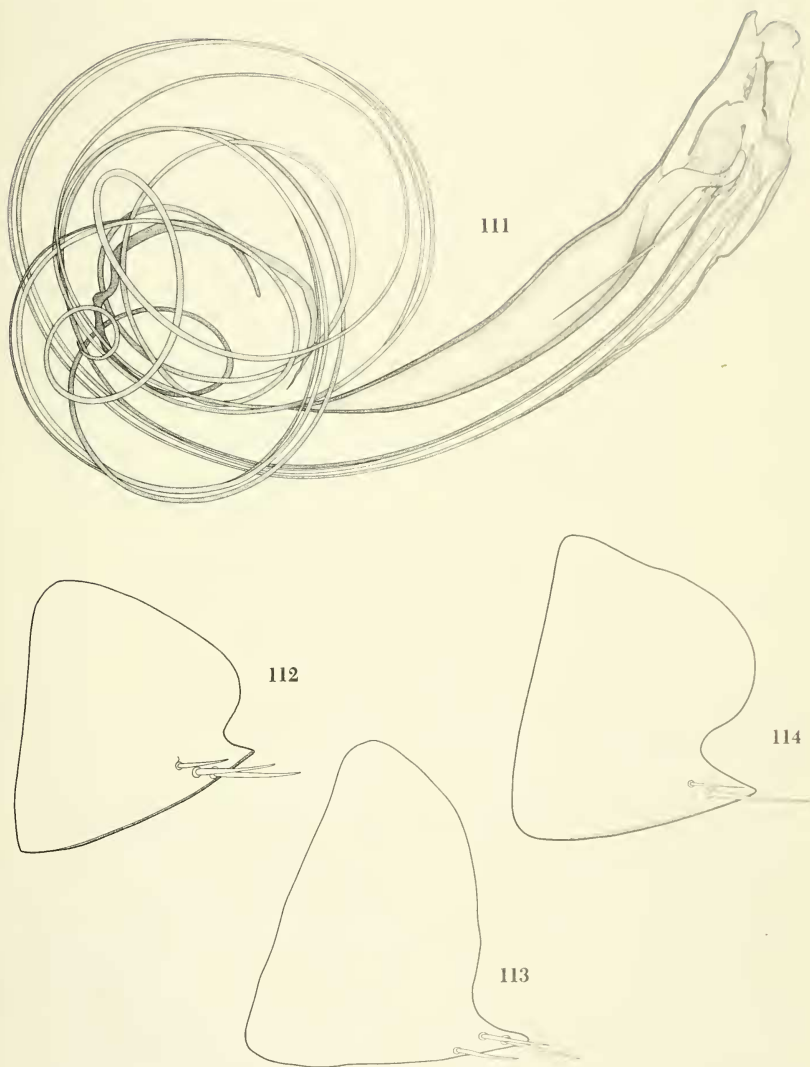


109



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Figs. 109-110. Males, aedeagus; 109, *Stenistomera hubbardi*; 110, *S. macrodactyla*.



Figs. 111-114. Males, aedeagus; 111, *Stenistomera alpina*, sternum VIII; 112, *S. alpina*; 113, *S. macrodactyla*, 114, *S. hubbardi*.

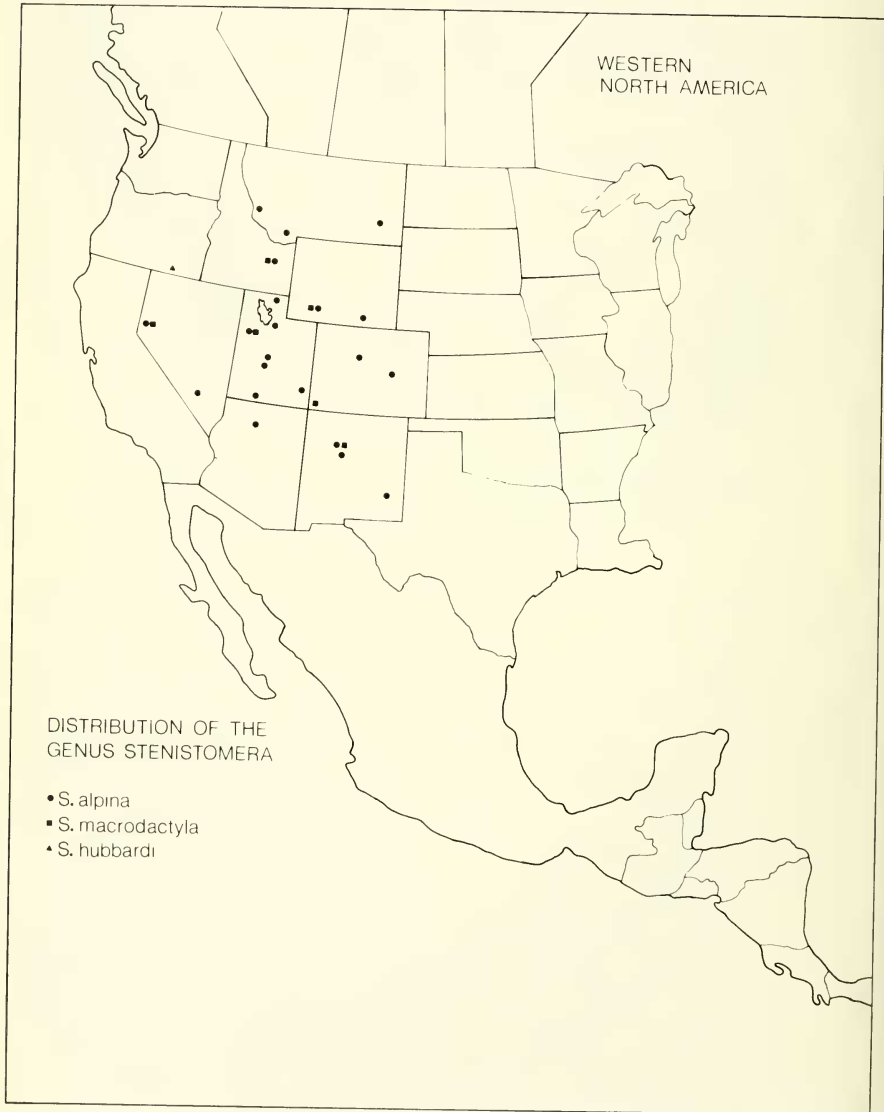


Fig. 115. Distribution of *Stenistomera alpina*, *S. hubbardi* and *S. macrodactyla*.

Stenostomera alpina (Baker), male and female, ex *Neotoma lepida*, Mercury, AEC-NRTS, Nye County, Nevada, 11-III-1960, collector unknown (BYU).

Stenostomera hubbardi Egoscue, male and female, ex *Peromyscus maniculatus*, 8.0 km S at Crane, Harney County, Nevada, 23-X-1966, H.J. Egoscue.

Stenostomera macrodactyla Groot, male and female, ex *Peromyscus maniculatus*, AEC-NRTS, Bingham County, Idaho, 19-XI-1967, collector unknown (BYU).

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